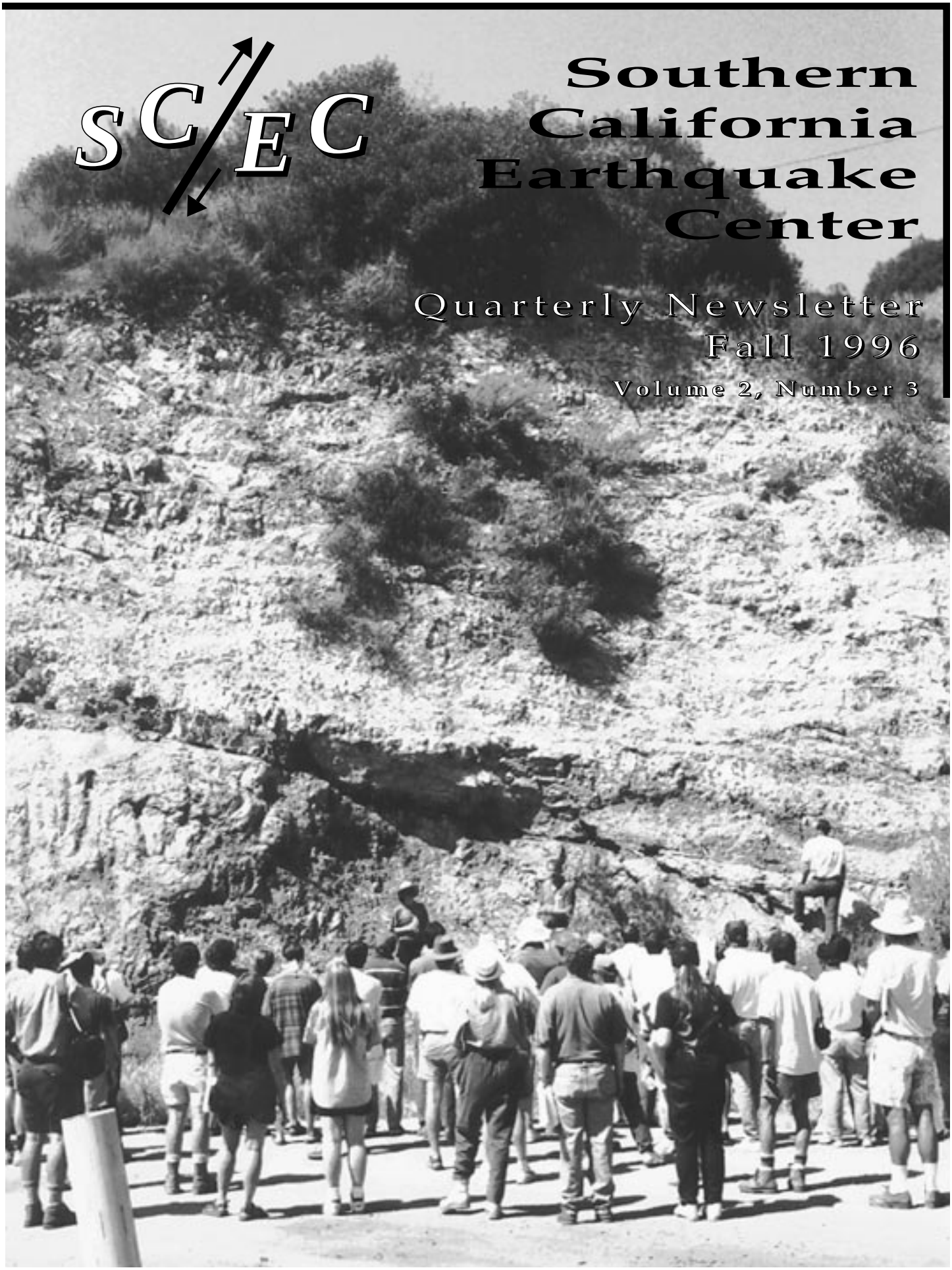


# Southern California Earthquake Center

Quarterly Newsletter
Fall 1996

Volume 2, Number 3

## *From the Center Directors...*

Center Director

Science Director

# The Dilemma of Federal Funding

Over the last twenty years, support for earthquake research in southern California has come largely from the federal government. Federal dollars from US Geological Survey (USGS) and National Science Foundation (NSF) programs have supported a significant amount of basic earthquake science research, as well as the establishment of important seismological facilities such as the Southern California Seismic Network and, more recently, SCEC.

It now appears that with yet another infusion of dollars from both the federal government and the private sector, we will see a quantum jump in our seismological infrastructure as the new Global Positioning System (SCIGN) and broadband seismological (TERRAscope) networks come on line over the next few years. These facilities will be multi-million dollar activities, involving hardware acquisition, operations, and maintenance.

But with deficit reduction taking center stage in Washington, priorities constantly shifting, and funds for basic research dwindling, will we be able to take full advantage of these new facilities — i.e., will we be able to do the necessary science while at the same time keeping the networks state-of-the-art and fully operational? Much will depend on SCEC's efforts, as well as the earthquake research community pulling together and becoming more proactive, both collectively and individually, in seeking the necessary resources.

Specifically, we must work with the State of California. SCEC and the new GPS and seismic networks are important additions to the State's arsenal for earthquake hazard assessment and disaster response and recovery, yet few State dollars support these initiatives. The California Division of Mines and Geology, the California Seismic Safety Commission, and the California Council on Science and Technology all recognize the need for more State resources. We must find ways to support their efforts on our behalf, and on behalf of a more advanced and sustainable earthquake science and engineering effort in California. ♦

*Tom Henyey*

# What Is the Southern California Earthquake Center?

The Southern California Earthquake Center (SCEC) actively coordinates research on Los Angeles region earthquake hazards and focuses on applying earth sciences to earthquake hazard reduction. Founded in 1991, SCEC is a National Science Foundation (NSF) Science and Technology Center with administrative and program offices located at the University of Southern California. It is co-funded by the United States Geological Survey (USGS). The Education and Knowledge Transfer programs are co-funded by the Federal Emergency Management Agency (FEMA). The Center's primary objective is to develop a "Master Model" of earthquakes in southern California by integrating various earth science data through probabilistic seismic hazard analysis. The SCEC promotes earthquake hazard reduction by:

- Defining, through research, when and where future damaging earthquakes will occur in southern California;
- Calculating the expected ground motions; and,
- Communicating this information to the public.

To date, SCEC scientists have focused on the region's earthquake potential. Representing several disciplines in the earth sciences, these scientists are conducting separate but related research projects with results that can be pieced together to provide some answers to questions such as *where* the active faults are, *how often* they slip, and *what size* earthquakes they can be expected to produce. Current work focuses on seismic wave path effects and local site conditions for developing a complete seismic hazard assessment of southern California.

Information: Call 213/740-1560 or e-mail *ScecInfo@usc.edu*

# Sixth Year Site Review Report

## SCEC Representatives Host Site Review Team at University of Southern California Campus

During a three-day, sixth-year review in late August, SCEC hosted a Visiting Committee from the National Science Foundation (NSF) and the United States Geological Survey (USGS). Members of the Site Visit Committee included James Beavers (MS Technology Inc.), George Davis (University of Arizona), Karen Fischer (Brown University), Carl Kisslinger (University of Colorado), Charles Langston (Pennsylvania State University), Francis Wu (SUNY at Binghamton), and James Whitcomb (NSF Program Director for Geophysics).

This was a critical milestone for the Center in that the results of the review will define, in essence, where we go in the next five years. SCEC directors, group leaders, scientists and student interns presented a formal overview and poster session highlighting both the Center's current scientific and outreach activities and our future plans.

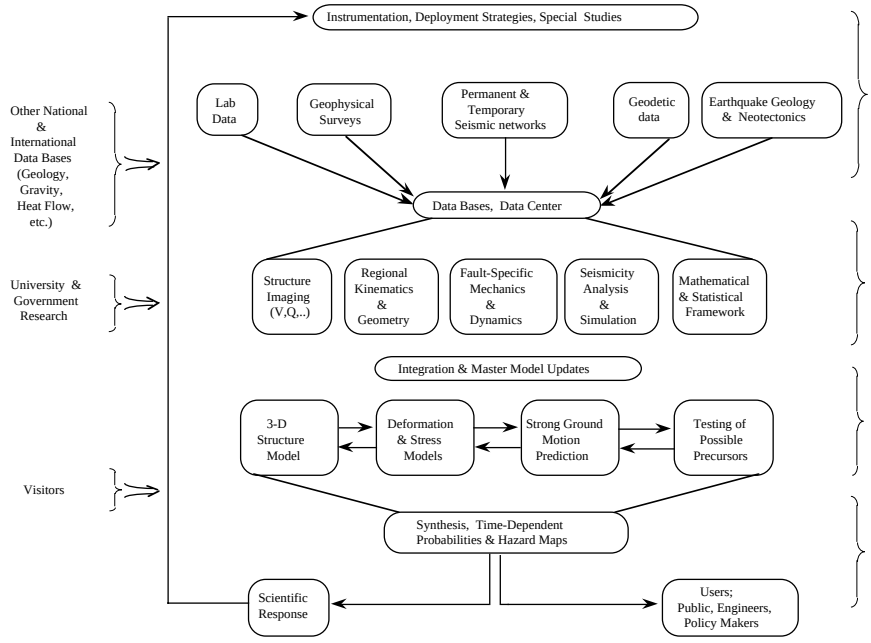
Before the site visit, SCEC directors conducted a self-review using the Center's own demanding criteria. The Center's original goals of promoting scientific research in earthquake hazards, integrating results using the master model, and communicating research results to end users has proven relevant, based on positive responses from earth scientists, engineers, and end users in the community-at-large. The Site Visit Committee concurred with this assessment.

SCEC's strengths in research integration continue to be evident in master model construction (see Figure 1, Master Model). The Center's Phase II report, ("Seismic Hazards in Southern California: Probable Earthquakes, 1994-2024,"), the soon-to-be-released Phase III report (which will include path and site effects), and the master model data bases maintained at various SCEC institutional sites are three examples. In addition, the Center-

***See "Review"*** *on Page 4*

THE MASTER MODEL

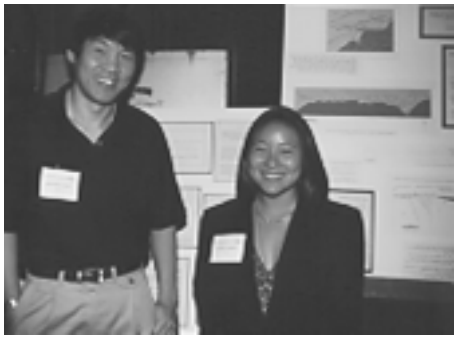
The master model has had a significant impact in the earthquake scientific and hazard assessment communities, judging from hundreds of inquiries from scientists outside SCEC, and sales of thousands of copies of the Phase II report. Master model products and data are being used by the State and national hazard mapping programs, consulting geologists for ground motion prediction, local government for variable seismic zonation, and the insurance industry for risk analysis. This master model was the first version created in 1991, before Center scientists solicited feedback from end users. The master model will be reconfigured at the 1996 Annual Meeting, to reflect changes in both the scientific and education and outreach approaches.



## Review *continued from Page 3 ...*

sponsored bibliography includes over 336 publications as of mid-1996. Most are refereed publications in premier journals.

Posters were presented by SCEC summer interns at the NSF/USGS Site Review. Clockwise, from top: Post-doc Ned Field and Warren Washington (National Center for Atmospheric Research, Boulder, CO); NSF's Sonja Sperlich with Kathleen Hodgkinson (USGS, Menlo Park); Mandy Johnson and Zheng-kang Shen; and Tom Henyey with Maggie Glasscoe(USC) and Julie Pappas (USC).



The Site Visit Committee recognized that both scientific and end user interactions are indications of the Center's strength. Scientific workshops, seminars, and group and annual meetings have provided rich forums for discussing data and new ideas. Workshops involving geotechnical engineers have resulted in effective cross-disciplinary dialogue on issues such as ground motion prediction, non-linear site effects, and probabilistic seismic hazard analysis. The "C-Cubed" program (Caltrans and the City and County of Los Angeles), is one example of how working relationships between engineers and earth scientists can be successful. Also noted by the Site Visit Committee are the effective working relationships the Center has developed with the USGS, the California Division of Mines and Geology (CDMG), the California Seismic Safety Commission, the Governor's Office of Emergency Services, local governments, and other special interest groups. In addition, numerous workshops, seminars, and field trips are regularly held for various user groups.

The Center publishes this quarterly newsletter and anticipates stepping up its publishing activities in the next five years. We have clearly increased earthquake awareness in southern California through our distribution of "Putting Down Roots in Earthquake Country," the Phase II report, and spots on radio and television.

A significant portion of funding has been dedicated to graduate student and post-doctoral education, through individual grants to principal investigators and the visitor's program. The quality of students and post-docs has generally been high. And the Center is now developing effective programs to reach out to secondary school teachers and students. One example cited by the Site Visit Committee is a new program in curriculum enhancement with the Palos Verdes School District.

The site visit presentations covered a wide range of subjects. Partnership opportunities were discussed by Jim Davis (CDMG) in the areas of probabilistic seismic hazard analysis fault parameters and databases, ground motion recording and archiving, and outreach and communication. Jim Mori (USGS) described cooperative projects including the Los Angeles Region Seismic Experiment (LARSE), "Putting Down Roots in Earthquake Country," the Southern California Integrated GPS Network (SCIGN), and an earthquake response plan. Mori cited SCEC's leadership roles in the Earthquake Program in the areas of education and outreach (workshops, curriculum development), and infrastructure (the data center, portable seismic instrumentation, and scientific seminars and workshops).

The Science Director's overview (David Jackson) consisted of a discussion of SCEC's basic scientific approach to, and develop-

***See "Report"*** *on Page 5*

## Report *continued from Page 4 ...*

ment and implementation of, the master model. He described how the Center "gang tackles" such mega-projects as Phase II, LARSE, and SCIGN. Jackson also identified some of the important scientific questions to be addressed over the next few years.

Other presentations included "Future Earthquakes, Where and How Big?" by Kerry Sieh (Caltech); "What Happens During an Earthquake Rupture?" by Steven Day (San Diego State University); "Focusing and De-Focusing, How Do Seismic Waves Interfere?" by Paul Davis (UC Los Angeles); "Engineering Implications, What Happens at the Site?" by Ralph Archuleta (UC Santa Barbara); "Engineering Applications, CUREe, C-Cubed" by Geoff Martin (University of Southern California); "Post-Earthquake Studies, What Have We Learned?" by Egill Hauksson (Caltech); and "Southern California Integrated GPS Network and GPS Results" by Ken Hudnut (USGS).

A series of status reports were also presented on the Southern California Seismic Network (Hauksson), the SCEC Data Centers (Rob Clayton, Caltech), the SCEC Education Program (Curt Abdouch), Knowledge Transfer Program (Jill Andrews), and Management and Leadership (Tom Henyey).

♦

*Jill Andrews and Tom Henyey*

### Review Team's Recommendations

**The Site Visit Committee summarized the strengths and weaknesses of SCEC with the following recommendations:**

**• The Site Visit Committee enthusiastically endorses SCEC's proposed science plan defining its mission for the next five years.**

**• The Site Visit Committee encourages SCEC to seek greater participation by women scientists in SCEC management, and to increase participation of under-represented minorities at all levels, with particular emphasis on SCEC education and outreach activities.**

**• The Site Visit Committee encourages SCEC management to continue its efforts at diversifying its sources of support for Center activities over and above NSF STC support.**

**• The Site Visit Committee recommends that SCEC management make a concerted effort to obtain substantial funding from the State of California.**

**• The Site Visit Committee encourages SCEC management to carefully reexamine scientific priorities in light of changes in funding for a special project to minimize detrimental effects on the general scientific/infrastructure budget.**

**• The Site Visit Committee agrees with the External Advisory Council that the Center develop a strategic plan.**

**• The Site Visit Committee congratulates retired Scientific Director Aki for his vision and service in helping to build SCEC, and has full confidence in new Center Director Henyey and Scientific Director Jackson for guiding SCEC through the next five years.**

**• The Site Visit Committee recommends that the Center be funded as requested.**

# NSF Director Lane Encourages Scientists to Reach Out to the Public

***In late August, NSF Director Neal Lane, who has called on scientists to become more active in communicating with the public, addressed the Arlington, VA Rotary Club. We feature excerpts from an article that appeared in* The Washington Post *following Lane's speech. —SQN Ed.***

## Excerpts

"...for me, this visit marks the beginning of what I hope will be an on-going dialogue with you....

"I must confess that I considered today's meeting such an important event that I wrote an editorial for the magazine, *American Scientist*, that I entitled *The Arlington Rotary Club*.

"The title, *The Arlington Rotary Club*, attracted considerable attention, as I had hoped, in a magazine which has probably never published those three words before, in any combination. Few things strike more fear into the hearts of scientists—who are otherwise extremely confident—than the prospect of speaking to an audience of many non-scientists. And so the article seemed to get a pretty careful reading.

"Scientists, as you probably already know, like to talk to each other. We have our conferences, workshops, and seminars where we converse in a jargon that can sound like its own form of *Close Encounters Of The Third Kind*.

"I am a physicist and I have been told that physicists are a bit odd. About a year ago the wonderfully witty journalist with *The Washington Post*, Joel Achenbach, wrote a tongue-in-cheek description of a physics conference. He said, 'When you picture a physicist you should imagine a person in darkness, holding a remote-control device, lecturing,...' Frankly, I don't see what is so strange about that! It's how I grew up! I hope I can offer some thoughts today with the lights on and the language accessible.

"In my editorial in the *American Scientist*, I spoke of the importance of scientists getting out of their labs, off their campuses, away from their computers, and into a dialogue with the American public. I used myself as an example of someone who lacks frequent experience in talking about science to audiences that are not scientists or specialists in science policy.

***See "Lane"** on Page 7*

## Southern California Earthquake Center Knowledge Transfer Program

The SCEC administration actively encourages collaboration among scientists, government officials, and industry. Users of SCEC scientific products (reports, newsletters, education curricula, databases, maps, etc.) include disaster preparedness officials, practicing design professionals, policy makers, southern California business communities and industries, local, state and federal government agencies, the media, and the general public.

Knowledge transfer activities consist of end user forums and workshops, discussions among groups of end users and center scientists, written documentation and publication of such interactions, and coordination of the development of end user-compatible products.

Planned and In-Progress Products and Projects include:

- Insurance Industry Workshops; Proceedings; Audio tapes
- Engineering Geologists' Workshops; Proceedings; Geotechnical Catalog.
- Vulnerability Workshops, City and County Officials
- Media Workshops
- Field Trips
- Quarterly newsletter
- "Putting Down Roots in Earthquake Country" Handbook
- WWW SCEC Home Page (*http://www.usc.edu/go/scec*)
- SCEC-Sponsored Publications; Scientific Reports

**For more information on the Knowledge Transfer Program, contact Jill Andrews, phone 213/740-3459 or email *jandrews@coda.usc.edu*, or Mark Benthien, 213/740-1560; e-mail *ScecInfo@usc.edu*.**

## Lane *continued from Page 6 ...*

"...In a sense, NSF gives grants to people who pose probing and insightful questions and then relentlessly test the answers till they create new kernels of knowledge and understanding. These kernels are like pebbles tossed into a pool of water. They generate an ever expanding series of circles—circles of open knowledge for others to contemplate, add to, and combine for amazingly varied and practical uses.

"The Nobel prize-winning physicist, Charles Townes, proved the concept behind the laser in the 1950s. [He was not supported by NSF but by our Wilson Blvd. neighbor, the Office of Naval Research (ONR).] This discovery was the pebble that eventually led to commercial lasers that read compact disks, perform eye surgery and burn away blood clots, and pulse phone calls and computer data through thousands of miles of optical fiber. It is speculated that there are many more circles to come from this one pebble. And so you might say that we and our fellow science agencies are in the business of funding 'pebble shooters.'

> ***"...our surveys show that the public is interested in science, ... but nonetheless those surveyed also believe they have very limited scientific understanding. ...this disconnect between the public being interested in science yet feeling that their knowledge is very limited should give all of us something to ponder."***

"At NSF, all of our surveys show that the public is interested in science, and believe science is important but nonetheless those surveyed also believe they have very limited scientific understanding. When I mention this to scientific audiences I suggest to them that the survey results perhaps tell us more about the science community than about the American public. I have pointed out that this disconnect between the public being interested in science yet feeling that their knowledge is very limited should give all of us something to ponder.

"There is no doubt that scientists are intense about what they're doing and the minutia of their particular discipline or sub field. And yet everyone, scientists included, should be able to explain what they do and make it sound sensible or relevant. If I were a surgeon, or a plumber, or a journalist, or even a musician, I could report on the kind of surgeries, leaky faucets, news stories, or compositions I had worked on. When you're a scientist, the things that you do on any given day in the laboratory are not very interesting even to your spouse, although you find them completely absorbing. I know this from personal experience.

"And so there is this odd contradiction because almost all people are interested in how things happen or why they happen or how they work, but there is a narrow and minute level of detail that most scientists work at that can quickly baffle or bore even other scientists. A partial solution to this disconnect is to educate scientists on how to be better communicators not only about their particular work but about the role and value of science and technology to society. Some scientists are skilled communicators—Carl Sagan, Stephen Gould—but the number is small.

"While on the one hand, science seems very remote to most people, it is, on the other hand, completely pervasive in our lives. The world is so infused with the stuff of science that we often don't recognize how it permeates every detail of our daily routine.... [At this point, Lane cited various uses of technology.]

"So, why do I think it is important for scientists to get out of their labs and engage in a genuine dialogue in their communities? It is not because I think that they have the only important things to say, but rather that they need to hear what everyone else has to say, as well as offer their own information and opinions. Will this make them better scientists? Probably. I have frequently pointed out that in America we are able to do out-

> ***"...everyone, scientists included, should be able to explain what they do and make it sound sensible or relevant."***

standing science at the same time that many societal disparities and problems are increasing. Maybe the most important goal should be to understand the physical, moral, and social problems that hold us in the grip of numerous contradictions. Surely we can only do this together, through regular and open discussions.

"Now, am I suggesting by my comments that science is not important or inherently useful? Just the opposite. The contributions of science and technology to our society translate into high economic and social value. Economists of all political stripes have estimated that our national investments in support of science and technology activities yield rates of return in the range

***See "Lane"*** *on Page 10*

## SCEC Research Report

# Monitoring the Post-Seismic Changes of the Landers Fault Using Fault Zone Trapped Waves

In early August of this year, a research team from the University of Southern California (USC) collaborated with researchers from the US Geological Survey (USGS), Incorporated Research Institutes for Seismology (IRIS), and the University of California at Santa Barbara (UCSB) to carry out an experiment in the Landers area of the Mojave Desert. The purpose of the project was to record explosion-excited seismic guided waves trapped in the fault zone that ruptured in the M7.4 earthquake of 1992.

L-R: David Bowman, David Adams, Yong Gang Li, Joel Wedberg (all USC), and Arturo Suria (IRIS). Yong Gang Li identifies the instrument deployment locations around the Landers fault zones.

This experiment, supported by the National Science Foundation (NSF) and the Southern California Earthquake Center (SCEC), is a duplicate of the previous experiment conducted in 1994: to monitor any possible changes in fault geometry (the width, depth and shape) and physical properties (velocity, porosity and material quality) after the Landers earthquake, using fault-zone trapped waves.

Principal Investigators Yong-Gang Li and Kei Aki, with other scientists, have published a series of papers on fault-zone guided waves (in *Science*, *Journal of Geophysical Research*, and the *Bulletin of the Seismological Society of America*). The papers show that fault-zone guided waves can be used to probe the state of the fault zone, because these guided modes are formed by multiple reflections within the fault zone, and their features strongly depend on the geometry and physical properties of the fault. The PIs and their colleagues have successfully observed these distinct waves from earthquakes at many active faults in California, including the San Andreas fault at Parkfield, the San Jacinto fault near Anza and the fault at Landers. These experiments should advance our understanding of the static and dynamic mechanisms associated with earthquake occurrence on these faults.

In the present experiment, three 4-10 km-long linear arrays consisting of 68 PASSCAL portable instruments were deployed across and along the fault trace between Yucca Valley and Homestead Valley. Three explosions using 500-1200 pounds of chemical emulsions were detonated within the fault zone at distances of 2 km, 5 km and 15 km from the mainshock epicenter of 1992. The 68 recorders worked in a continuous recording mode not only for the explosions but also for aftershocks (there are still more than ten microearthquakes occurring there per day). The PASSCAL instruments and the team members all suffered through the intense desert heat, with temperatures soaring as high as 120 °F.

A unique data set was collected from both the explosions and the aftershocks, including a M 4.5 event on August 14. These data will be used for a comparison with those recorded in the 1992 and 1994 experiments to search for any changes in features of fault-zone trapped modes. The results will be reported at the Fall meeting of the American Geophysical Union. ♦

*Y. G. Li*

1

2

4

Clockwise, from top left:

1. The IRIS consortium instruments used for seismic data acquisition, including a personal computer, REFTEK data recorder, and GPS satellite antennae and receiver.

2. Three component geophones, such as this one, picked up signals from the Landers seismogenic zone.

3. This concrete foundation was separated and offset during the rupture of the 1992 M 7.5 Landers earthquake.

4. Batteries will keep individual stations running for a week.

3

## Lane *continued from Page 7 ...*

of 20-30 percent. I wish I could find a broker who would promise a similar return, an honest one.

"One need look no further than the streets of Arlington to find high-tech industry. There are major players like MCI and American Management Systems. Just as important, however, is science and technology as a driver of small business development. I know I can rely on you to provide me with the best examples from your own experience.

"Suffice it to say that all these returns flow back to our society in new industries, high-value jobs, and highly competitive products and services for the domestic and global marketplace. They bring us better health care, a cleaner environment, and an improved standard of living. Despite this, science by itself cannot answer the hardest questions.

"The most fundamental problems in all societies are human problems and they are similar on the local and global scale. How can we nurture and educate all children, inhibit violence, provide meaningful work for all? Science can help solve these and myriad others that exist. But science is only one of numerous components that are needed.

"I am asking scientists and engineers to actively reach out in their communities and engage in a genuine dialogue. I am asking you to reach out to scientists, and technical professionals as you have done to me, and share with them the problems and issues of concern in this community. Rotarians, especially, have the gift of reaching out. Together, we can keep talking and moving toward beneficial solutions." ♦

## Open Letter from John McRaney, SCEC Director for Administration

**To SCEC Scientists and Friends,**

I hope everyone had a wonderful summer. I would like to bring you up to date on several items.

1. The eight-month process to prepare, submit, and defend the SCEC Five-Year (1997-2002) renewal proposal is now over. The Steering Committee began work on the renewal in January with a day-long session where committee members presented their ideas on the future direction of SCEC. During the spring, several drafts were written and circulated among the committee. The final proposal emphasis was approved by the board in early June and the proposal was completed and submitted to NSF in late June.

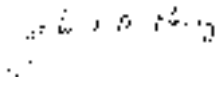
The science proposal was primarily written by David Jackson, Science Director, and Tom Henyey, Center Director, with Ralph Archuleta, Egill Hauksson, and Kerry Sieh. Jill Andrews and Curt Abdouch prepared the education and outreach section. The process was completed when review teams from NSF and USGS visited USC in late August (see Review Report, page 3 of this SQN). At this review, members of the Steering Committee (with help from Paul Davis and Norm Abrahamson) made presentations on the current status of SCEC and the new research thrusts presented in the proposal. Several round table discussion sessions also took place with Steering Committee members. Approximately 20 post-docs, graduate and under graduate students prepared posters and had a discussion session with the site team.

Based on the written reviews of the proposal (all checked excellent) and the favorable comments made at the site visit, we feel confident that SCEC will continue to be funded for the next five years.

2. We received written confirmation of NSF approval of the new SCEC directors. Tom and Dave are now officially in charge.

3. There are several changes to the Board and Steering Committee. Charles Sammis has replaced Kei Aki as the USC member on the Board. In honor of his service to SCEC, Kei Aki has been given the status of Director Emeritus and made an ex-officio member of the Steering Committee. Dave Jackson has replaced Aki as leader of the Master Model Working Group and Ken Hudnut has replaced Duncan Agnew (on sabbatical in New Zealand) as leader of the Crustal Deformation Working Group. Jim Davis (CDMG) and Will Prescott (SCIGN Coordinating Board Chairman) have been elected as ex-officio members of the Steering Committee.

4. The SCIGN program is moving ahead. SCEC recently received a $2M grant from NSF (through the ARI program) to expand the permanent GPS array in southern California. More on this activity will be presented at the annual meeting in late October.



# SCEC Scientists' Publications

**SCEC Quarterly Newsletter Now Highlights Recent Publications**

Beginning with the current issue, SQN will highlight recent publications of SCEC scientists in an expanded format and also provide more in-depth information such as abstracts or interviews with authors. We will continue to provide a complete bibliographical listing of SCEC research publications in the Spring issue each year. The most recent publications by SCEC researchers are listed on page 21.

We plan to expand our database of publications of research funded by SCEC to include abstracts. We are asking all SCEC-funded researchers who wish to have their publications included in the database, to email or fax Mark Benthien, SCEC Outreach Specialist (contact information below), with information on the authors, title, publication name and any other bibliographic information that is known. We are asking that this be done *before submitting a paper*, in order to facilitate assignment of the "SCEC contribution number" for the acknowledgment section. This will greatly improve the function of the SCEC database, allowing for key word searches in both the title and abstract of all papers. This database will soon be available on the Internet at SCEC's home page: *www.usc.edu/go/scec.*

For each issue of the SCEC Quarterly Newsletter, selected abstracts will be taken from the database and printed, with further information or interviews with selected authors.

Please support both new projects by emailing or faxing both past (if readily available) and future abstracts of your SCEC-funded publications.

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**fax (213)-740-0011**

## *The Geology of Earthquakes* Now Available

***The Geology of Earthquakes* by R.S. Yeats, K.E. Sieh, and C.R. Allen: Oxford University Press, 576 pages**

This is the first modern textbook on earthquake geology which draws examples from many seismically active regions of the globe, including China, Japan, the Mediterranean countries, New Zealand, and the United States. The authors have written the book as a valuable reference for the community of practicing engineers, geophysicists and planners as well as geologists; and as a textbook for graduate and advanced undergraduate students. For readers with little or no geological or geophysical background, the first seven chapters provide information on plate tectonics, structural geology, earthquake waves, geodesy, time scales and dating techniques, and tectonic geomorphology. These are followed by a discussion of earthquake environments: strike slip, reverse, normal, and subduction zones, plus a chapter on secondary effects such as liquefaction, seismically induced landslides and tsunamis. Case studies throughout the text of recent, well-studied earthquakes demonstrate the interdisciplinary nature of earthquake science. The final chapter details the latest methods and breakthroughs for seismic hazard assessment. All chapters contain the most recent studies, referenced in both "Suggestions for Further Reading" at the end of each chapter as well as an extensive 50-page bibliography.

The authors' intent for the book to be used as a reference is evident in the exhaustive appendix, which includes a table of more than 300 historical earthquakes with surface rupture, a complete glossary, bibliography, and a comprehensive index of both terms and names. Finally, throughout the book are personal vignettes of early pioneers including Gilbert, McKay, Koto, Darwin, and others.

### The Authors

**Robert S. Yeats** is Professor of Geology and Oceanography at Oregon State University and is chairman of the Task Group in Paleoseismology, Inter-Union Commission on the Lithosphere.

**Kerry E. Sieh** is Professor of Geology at the Seismological Laboratory of the California Institute of Technology, a member of the National Academy of Sciences Committee on the Science of Earthquakes, and a recipient of the National Academy of Sciences Award for Initiatives in Research.

**Clarence R. Allen** is Professor Emeritus of Geology and Geophysics at the California Institute of Technology, a past-president of both the Geological Society of America and Seismological Society of America, and a member of the National Academy of Sciences and the National Academy of Engineering. He is also the 1996 recipient of the Medal of the Seismological Society of America.

*The Geology of Earthquakes* is available direct from the publisher at 800-451-7556, by company purchase order or credit card (Visa, Mastercard and American Express). It may also be ordered through major bookstores. ♦

*Mark Benthien*

# *Quarter Fault*

# The San Cayetano Fault

**Each Issue of the SCEC Newsletter features a southern California fault. In this issue...**

***Length: 40 km***
***Slip Rate: 4 -11.8 mm/yr***
***Cumulative Offset: 10.1-11.8 km***
***Maximum Magnitude: 7.2***
***Recurrence Interval: 500 years***

**The San Cayetano, a 40 kilometers-long, north-dipping reverse fault, bounds the Santa Clara Valley on the south. Located west of the Santa Susana fault, the San Cayetano may have a slip rate of over 10 millimeters per year. This could make it the fastest slipping thrust fault in the Transverse Ranges.**

**For this newsletter, Bob Yeats, Professor of Geology and Oceanography at Oregon State University, was kind enough to discuss the San Cayetano with the writer. Yeats, who has co-authored a new geology textbook with Kerry Sieh and Clarence Allen (both of Caltech), has supervised several 3-D studies of the fault using oil field data. (See the SCEC review of *The Geology of Earthquakes*, page 11 of this newsletter.)**

## Interview with Bob Yeats

**SCEC:** James Dolan (University of Southern California) has estimated that the San Cayetano fault could produce a M 7.2 event every 500 years. What effect, in your opinion, would this have on Los Angeles?

**Yeats:** A M 7.2 earthquake could produce some damage in Los Angeles. This is due to an effect that was demonstrated in 3-D basin modeling by Kim Olsen, Ralph Archuleta, and Joe Matarese (of UC Santa Barbara, in the *Bulletin of the Seismological Society of America*, 86, 575-596, 1996). An increase in amplitude and a decrease in the speed of surface waves occurred in the model. I don't know if the damage would be major, however. Olsen et al. modeled an earthquake occurring on the San Andreas fault as the source, but such modeling has not yet been done to predict the effects of a M 7+ event in the Ventura basin.

**SCEC:** Has the San Cayetano fault produced a significant earthquake in the last 500 years?

**Yeats:** We do not know. This is one of the purposes of the trenches Dolan and Rockwell are excavating on the San Cayetano. The problem is that there are very few suitable trench sites, but they have selected some that have promise.

**SCEC:** What is the slip rate and the range of offsets for the San Cayetano that you and Gary Huftile (Oregon State University) have produced?

**Yeats:** We've summarized that information in Huftile and Yeats, the *Bulletin of the Seismological Society of America*, 86, 1B, s3-s18 (1996) Northridge special issue. The information in that paper postdates SCEC's *Phase II* report but will be incorporated into *Phase III*, due for release in early 1997. We calculate 2.2-5.2 km dip slip in the last 500 ky and 10.1-11.8 km of dip slip in the last 975 +/175 ky for the Modelo lobe. The Modelo lobe is the eastern lobe of the fault where the displacements are largest. This gives us a slip rate of 4.4-10.4 mm/yr for the last 500 ky and 10-11.8 mm/yr for the last 975 ky (see table 1 of Huftile and Yeats, 1996). The western San Cayetano fault has lower slip rates decreasing to zero in the Ojai Valley, but this is because part of the fault is a blind thrust uplifting Sulphur Mountain. (For reference, see the eastern cross section in Huftile and Yeats, *Journal of Geophysical Research*, 100, 2043-67,1995).

***See "San Cayetano" on Page 13***

## San Cayetano *continued from Page 12 ...*

**SCEC:** Was the San Cayetano originally a normal fault which was reactivated as a strike slip fault?

**Yeats:** Possibly. In Yeats et al., *American Association of Petroleum Geologists* 78,1040-1074 (1994), we map a SE trending trough, dated in the late Miocene, from the outcrop in the condor refuge north of Fillmore to the subsurface NE of the Santa Susana Mountains. The SW edge of this Miocene trough could be the site of the Pleistocene San Cayetano fault, but because the oldest sediments in the footwall of the San Cayetano are upper Pliocene, we can't demonstrate that. If so, then the San Cayetano reactivated an old normal fault, as did the Santa Susana fault farther SE, as discussed by Yeats et al. (1994).

**SCEC:** Where is the best place to view the fault?

**Yeats:** Silverthread oil field in the upper Ojai Valley. Rockwell and Huftile led the SCEC field trip there last fall. *(See cover photo —SQN Ed.)* ♦

***See "San Cayetano"*** *on Page 14*


Above: Map showing the location of the San Cayetano fault, with relation to the Santa Susana (SSF), Oak Ridge, Santa Monica Mountains and Santa Monica faults. The barbs point down dip on the faults. Dark spots indicate the geometry of recent ruptures. The likely maximum magnitude event and its recurrence interval is indicated for each fault. (Figure modified from Dolan et. al, Science, 267, 199-205, 1995)

Courtesy Tom Rockwell

The chaparral covered Eocene rocks along the skyline form the hanging wall of the San Cayetano fault in the Orcutt Canyon area, where Eocene rocks are thrust 7 to 8 km (stratigraphic separation) over overturned mid-Quaternary marine deposits of the Fernando formation. View is to the north.

San Cayetano fault in the upper Ojai Valley looking east. Sisar Canyon fan is in the foreground and the San Cayetano is expressed as a prominent scarp, vertically displacing the fan by nearly 100 m. In the distance, the San Cayetano brings overturned Eocene rocks on the north (left), over overturned Quaternary deposits of the Fernando formation to the right.

Courtesy Tom Rockwell

**San Cayetano** *continued from Page 13 ...*

## More Observations on the San Cayetano from SCEC Scientists Tom Rockwell and Ralph Archuleta

**The San Cayetano fault and the Oak Ridge fault are the focus of a SCEC field trip to be scheduled in 1997 and led by San Diego State University professor and SCEC scientist Tom Rockwell. Rockwell, who this year has trenched sites in Israel, Turkey and Mongolia, was available for comment, as was UC Santa Barbara seismologist and SCEC Board member Ralph Archuleta. Rockwell did part of his Ph.D. thesis work on the San Cayetano, and authored one of the seminal papers on the fault (*Geological Society of America Bulletin,* 100, 500-513, 1988).**

**SCEC:** Why does the San Cayetano fault have two lobes?

**Rockwell:** There's a lateral ramp between the two, which runs along the east side of Sespe Creek and separates the San Cayetano into two lobate segments. The eastern segment is much more lobate than the western and has a lower dip in the upper several kilometers.

**SCEC:** Is the primary purpose for the trenches you're doing with Dolan to look at the fault's slip rate?

**Rockwell:** The intent of the trenching is to resolve the timing of the most recent earthquakes, and, if possible, the amount of slip in those earthquakes. We suspect that whatever slip values we come up with for the western segment, they will be minimums, considering the extensive late Quaternary deformation of the footwall indicating a blind component of slip.

**Ralph Archuleta**, on strong ground motion during a hypothetical M 7.2 earthquake:

For a San Cayetano rupture, the directivity effect would be felt strongly in the direction of Los Angeles, because the rupture would proceed updip going from north to south. That would certainly be different from the 1994 Northridge earthquake, when the rupture went basically southwest to northeast. As Yeats may have mentioned, the Ventura basin has as deep a section of sediments as Los Angeles (The Oxnard plain). A M 7.2 event on the San Cayetano could produce some very significant amplification and basin edge effects here. ♦

*Michael Forrest*

## *Save the Date!*

# Join us for the Southern San Andreas Fault Field Trip

### Friday and Saturday, December 6 and 7, 1996

**with Dr. Kerry Sieh**

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*Feature: visit with a SCEC scientist*

# Mark Legg

## Profile

**M**ark Legg's field area is the Southern California Borderland. While some scientists discount the possibility of destructive tsunamis occurring along coastal Los Angeles, Orange and San Diego counties, Legg believes they are inevitable.

Legg, unlike many of his colleagues, is also convinced that current published probabilistic seismic hazard estimates for the coastal region are "too low." "Nobody really knows the slip rates on these offshore faults, except for those which are known to pass onshore," says Legg. "Without accurate accounting of the offshore earthquake threat, estimates of seismic hazards in the coastal zone, as currently presented, underestimate the risk. The Borderland area covers approximately one third of the southern California area, yet has half of the faults—and we don't have numbers for them," observes Legg.

Mark Legg received a B.S. in Space Science and Mechanical Engineering *magna cum laude* from the Florida Institute of Technology in 1973. His M.S. in Oceanography is from Scripps Institution of Oceanography (1980) and his Ph.D. in Geological Sciences is from U.C. Santa Barbara (1985).

He is a Senior Scientist at Torrance-based ACTA Inc. since 1989. ACTA Inc. specializes in risk assessment for both natural and man-made hazards. He is also an Adjunct Professor at San Diego State University and a Visiting Assistant Research Geophysicist at the Institute for Crustal Studies at UC Santa Barbara. Legg and his wife Joyce have two sons, Geoff (11) and Justin (almost 8).

## The Interview

**SCEC:** The largest recent earthquake that occurred just off our coast was the M 5.8 Oceanside earthquake in 1986. What can you tell us about it?

**Legg:** The earthquake occurred on the restraining bend of an unknown thrust fault that is clearly constrained by the right-lateral San Diego fault block zone. On a 1990 USGS cruise I was on with Dr. Robert Bohannon and Dr. Steve Eittreim of USGS Menlo Park (they were co-chief scientists for the May 1990 MCS cruise in the Borderland), we sailed over the epicenter of that earthquake and found that the San Diego Trough fault is essentially near vertical there. My best guess is that the Oceanside earthquake was on the Thirtymile Bank detachment fault, which is offset by the younger San Diego Trough fault. There is a bump on the seafloor there and all the aftershocks span the width of that bump. They extend all the way from the San Diego trough fault to the Coronado Bank fault zone.

**SCEC:** What is the maximum earthquake which could be generated by that fault?

**Legg:** The San Diego Trough fault could generate a M 7.5. Based on my thesis data at Scripps and Santa Barbara, it's a 50 to 200 km-long fault. But it's not the biggest fault we have to be concerned with out there. The biggest fault is the San Clemente, which has a length of at least 400 or 500 km and may extend as far south as Viscaino Bay.

***See "Legg"*** *on Page 16*

## Legg *continued from Page 15 ...*

**SCEC:** Is there any evidence that the San Clemente fault has ruptured in its entirety?

**Legg:** I don't know how we'd ever prove that. Certainly it's hard enough to prove on land. Look, for example, at the San Andreas fault. It has been suggested that the north and central Carrizzo Plain segment ruptured with the Coachella Valley segment, but even with the best land data, we just can't prove it.

What we can show is that faults like the San Clemente fault are very long, very continuous, narrow, well-defined faults. Their character is very much like the character of the San Andreas fault. We have the same sort of geomorphology, we have major restraining bends with seafloor uplift, we have extensional trans-tensional segments with sagging of the sediments into the extended fault zone, and these features are all consistently developed where the fault wiggles left into restraining bends, and right into releasing zones.

**SCEC:** Do you believe that the San Clemente fault may be as important a fault as the southern San Andreas in the tectonic evolution of southern California?

**Legg:** Yes, the San Clemente fault is very much like the San Andreas fault in character: very long, continuous, and very well defined. If we assume the San Clemente fault is the San Andreas of the offshore, it was most likely the main plate boundary fault prior to five million years ago for as long as 20 to five million years ago — three times as long as the San Andreas in southern California. Prior to five million years ago, the "offshore San Andreas" therefore jogged to the right which resulted in the rotation of the Transverse Ranges.

But activity on the San Clemente fault didn't stop when the plate boundary jumped into the Gulf of California at five million years. The fault is still active. I think based on its length and its well-defined character, that it could produce M 8 earthquakes. How frequently, I don't know.

**SCEC:** How far south does the fault extend?

**Legg:** It probably connects to the San Ysidro fault in Baja at its southern terminus. The important thing to remember is that the San Clemente fault, to our knowledge, does not cross Baja anywhere. So all the slip and seismicity on spreading centers in the mouth of the Gulf of California do not account for motion on the San Clemente fault. I believe current plate motion models are at least ten percent if not 20 percent slow, and that the San Clemente fault has perhaps ten percent of the Pacific-North American plate motion, about five mm per year. I base this estimate on geomorphic features which I see on the Fortymile Bank (40 miles west of San Diego). There are what I believe to be debris flows from a submarine fan slope apron debris flow complex that are progressively offset. I estimate they are a quarter of million years old. The larger features are offset ten km. There is a shudder ridge there which is controlling the sedimentation. We haven't done the detailed sampling necessary to prove the age of these deposits or to prove where they are derived from, but my estimate is based on morphology and high resolution seismic profiling.

**SCEC:** Is there any historical record of a large tsunami occurring in southern California?

**Legg:** I've talked to a NOAA investigator, who believes that the only major local tsunami in southern California on record occurred during the M 5.25 earthquake on August 30, 1930 in Santa Monica Bay. It was 20 feet high and caused one fatality. Santa Monica is semi-enclosed which produces local bay resonance. In the M 9.2 Alaskan (Prince William Sound) earthquake on March 23, 1964, the effects of the tsunami lasted for17 hours in Santa Monica Bay because of this resonance effect. It exceeded the tide gauge high (more than nine feet high at Marina del Rey), because that's the location of the antinode — the peak response site — for the Santa Monica Bay. The

*See "Legg" on Page 17*

***"Mark Legg is full of energy. He produces creative ideas that stimulate new directions for discussion."***

***Tom Rockwell***
***Professor of Geology and SCEC Scientist***
***San Diego State University***

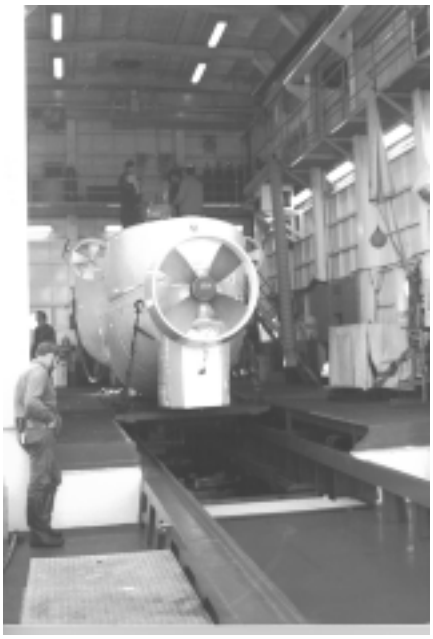
## Legg *continued from Page 16...*

water went up and down nine feet every 20 to 30 minutes. It destroyed a lot of watercraft. The same thing also happened in 1960 in the San Diego bay after the M 9.5 Chilean earthquake on May 22, 1960.

**SCEC:** Which offshore faults could potentially produce tsunamis in southern California?

**Legg:** All the major offshore fault zones: the San Clemente (the biggest), the San Diego Trough, Coronado Bank/Palos Verdes, the Rose Canyon/Newport-Inglewood, the Catalina, the San Pedro Channel, the faults in Santa Monica Bay, Anacapa-Dume, Santa Barbara Channel, the Oak Ridge fault, the Pitas Point fault, the Red Mountain fault, the North Slope fault zone. All these major offshore faults are active. The ones closer to the Transverse Ranges are thrust, so they have the greatest possibility of generating seafloor deformation and large tsunamis. But even the strike-slip faults have major restraining bends and releasing bends with possible seafloor uplift or subsidence.

I think you could have earthquakes big enough to trigger landslides ten to hundreds of km long, with these old detachment faults, and especially with slow earthquakes. The Newport-Inglewood fault, for example, has been reactivated as a strike-slip fault which runs through slippery rock, like the Catalina schist.



US Navy DSV Turtle. Legg is getting aboard (standing on top of vessel).

**SCEC:** Let's specifically consider the flatter beaches in L.A. or Orange County.

**Legg:** If we have a large earthquake, we may not have a tsunami. But if a tsunami is generated, the size of the tsunami at the source is generally comparable to the amount of seafloor deformation. If it's in deep water, the wave will be amplified when it gets to shallow water. The energy is spread through the entire water column, whereas the regular surf, the swell where the surfers ride, is only in the upper tens of meters of the ocean. So a large earthquake in 1000 to 2000 meters water depth, with a two-meter wave, may amplify to perhaps five to ten meters by the time it gets to the coast, depending on coastal geometry, refraction patterns, and so forth.

**SCEC:** So if you're sitting with your toes buried in the sand in Huntington Beach, you could actually look up into the blue sky and see a 30-foot wave come at you?

**Legg:** Absolutely. Local amplification can create such waves. And as we saw in the July 12, 1993 Hokkaido-Nasei-Oki earthquake (M 7.8), which caused a major tsunami at Okushiri Island, on the Sea of Japan, the tsunami averaged about five meters, in some places it was ten meters high, others only four meters high. But in one small narrow canyon on the steep coast, it went up 30 meters. They know it reached the 100-foot elevation in this canyon because there was seaweed draped over the telephone lines.

**SCEC:** Have you seen any of the seafloor faults firsthand?

**Legg:** My only submersible trip (to date) occurred in December of 1989 aboard the Navy DSV (Deep Submergence Vessel) *Turtle*. It was along the southwest side of Fortymile Bank. There are spectacular escarpments there, most of which are directly related to tectonic faulting, but major slope failures are also common in the area. My dive was very educational for myself, especially in demonstrating that large parts of the seafloor are covered with mud!

Toward the end of the dive, we reached the steeper scarps, where tidal or other bottom current scour kept the bedrock clean of mud, and I saw large piles of large boulders. The second dive in this Woods Hole Oceanographic Institute (WHOI)/Navy test cruise involved a young Navy cadet and M.S. candidate from M.I.T., Ms. Lynn Oschman. The dive was planned based on Sea Beam contour maps acquired during the previous night (after my dive) where we identified a small bench in the 500-m high scarp. From my dive, I had learned that the bottom currents in this area are quite strong and the bench was likely the only good place where *Turtle* could hold still long enough to get a sample.

***See "Legg"*** *on Page 18*

## Legg *continued from Page 17...*

Furthermore, I predicted that the bench was likely of tectonic origins, and we should get some fault rocks. Lastly, the steep scarp should have spectacular exposures for photography. When *Turtle* returned from this dive, I was elated to see a large (briefcase+ sized) chunk of rock which was covered with slickensides, retrieved from this bench. Lynn also told me that the scarp was near vertical for hundreds of feet, leveled off to about a 60-degree slope, flat for about a100-m wide bench, then became near vertical again. I have yet to see the video tapes or 35 mm slides from this dive (they are lost somewhere at WHOI), but I do have the rock, a fine museum specimen!

**SCEC:** What is the origin of Catalina Island?

**Legg:** Catalina Island may be a horst squeezed upwards due to transpressional motion on the Catalina fault (Catalina escarpment) and the San Pedro Basin fault zone. There are many theories on the origin of Catalina Island, but I know of no consensus at this time.

An important question is why there are no (or few) recognizable marine terraces on Catalina Island, whereas there are abundant well-defined terraces on all the other Channel Islands and Palos Verdes Peninsula. Perhaps the uplift has been very rapid, very recent, or the Catalina Schist and Miocene andesites which make up the bulk of the island are not favorable for terrace formation/preservation. It is likely that all of the Channel Islands are the result of faulting, either directly with major fault scarps bounding one or more sides like San Clemente Island, or via major low angle normal, reactivated as reverse faults like the Northern Channel Islands. Certainly all of these islands are fault-bounded blocks, and most are tilted. Los Coronados are beautiful examples of tilted fault blocks with a general 25-35 degree west-dip, equivalent to the dip we imaged in the MCS profiles offshore San Diego across Coronado Bank. Numerous submerged features like Coronado, Thirtymile and Fortymile Banks were also islands during Pleistocene lowstands of sea level, and they too are fault-bounded.

**SCEC:** Is there very much hydrothermal activity occurring on our own Borderland faults?

**Legg:** There may be abundant hydrothermal activity on these offshore faults. Only the hydrothermal vents along spreading centers, and recently along the Florida escarpment have received much attention. Peter Lonsdale from Scripps Institution of Oceanography found hydrothermal vents along the San Clemente fault near Fortymile Bank. Hydrothermal vents are well-known along coastal faults, such as Punta Banda (the Agua Blanca fault) and Carlsbad, where there was once a bath house. As seen on *Life & Times*, we observed Dandelions on the Catalina escarpment, which are creatures thought to be associated with hydrothermal activity. We did not recognize hydrothermal vents during those dives (saw no chimneys, black or white smokers, tube worm colonies, giant clams, or other vent fauna). It is entirely possible that such features exist along offshore faults, but very little of this enormous region has been surveyed by submersible or bottom photography.

**SCEC:** Are there any fundamental differences in the way offshore vs. onshore faults behave?

**Legg:** Underwater faults misbehave. They don't show themselves to paleoseismologists for trenching, so it can be very difficult to determine Quaternary earthquake histories for such faults. On the other hand, high resolution seismic methods and careful, well-navigated bottom sampling should allow accurate determination of Quaternary slip rates.

With regard to earthquakes on offshore faults, we know that large and small earthquakes occur on offshore faults of southern California: the largest seismographically recorded was the 1927 Lompoc earthquake (M 7.3).

Vertical stresses due to the water column should be less than an equivalent layer of granite for an onshore fault, but more importantly, we want to know, what is the influence of water in the fault zone?

Most, if not all, onshore faults extend below the water table, and so many onshore faults may be "wet." Rick Sibson (University of Otago, New Zealand) suggested that pseudotachylytes are fossil earthquakes on "dry" faults (the water would inhibit the melt). But he also noted that someone observed great quantities of water emanating from the overthrust granite of the White Wolf fault immediately following the 1952 Kern County (M 7.5) earthquake. Much debate and current research is focused on the influence of water in fault zones; it may help account for the "heat flow" deficit and low apparent stress in large earthquakes (pore pressure lowers the effective stress and water may remove heat via hydrothermal activity so that conductive heat flow measurements underestimate the heat generated along faults).

I think of more significance to offshore (submarine) faulting, especially in the California Continental Borderland, is the importance of hydrous minerals and possible dehydration/rehydration reactions during large earthquakes. This is because the Catalina Schist basement is equivalent to some parts of the Franciscan basement elsewhere in California; and the San Andreas fault is creeping where Franciscan basement is juxtaposed versus the granitic basement of Salinia and the Transverse Ranges and Peninsular Ranges.

***See "Legg"*** *on Page 19*

## Legg *continued from Page 18...*

Wayne Thatcher and Tom Hanks (US Geological Survey) and others studied stress drops, apparent stresses, etc. for southern California earthquakes and noted that Borderland events had low stress drops, especially compared to very high stress drops in the batholith (e.g., the San Miguel earthquakes). Thus, a given offshore event is likely to have greater slip and greater seismic moment for the local magnitude computed routinely by SCSN compared to most onshore events.

**SCEC:** We've heard that earthquakes produce a rumbling sound on land. What would earthquakes sound like underwater?

**Legg:** You should hear earthquakes much better in water than in air due to the acoustic properties of sea water. In fact, many ships have been strongly jolted by a "sea quake" when in the epicentral region of significant earthquakes. At greater distances from the source region, dispersion and attenuation would remove most audible frequencies. But I have beautiful records of the T-phases of a moderate (M 6) event located offshore Jamaica, and recorded several hundred miles away in the Cayman Islands region. The T-phase is the trapped acoustic wave in the ocean (trapped in the water column, and like the Navy sonar, it propagates across entire oceans in the Sofar channel with negligible attenuation. *[Editor's note: "Sofar" is an ocean acoustic waveguide, related to temperature and salinity.]* Some scientists think that T-phases may be a good indicator of a tsunamigenic earthquake, but reliable tsunami precursors are still unproven. ♦

*Michael Forrest*

### Selected Publications, Mark Legg


Legg, M.R., and J.E. Slosson, 1984, Probabilistic approach to earthquake-induced landslide hazard mapping, in *Proceedings of the Eighth World Conference on Earthquake Engineering, San Francisco, CA*, p. 445-452.

Taylor, C.E., M.R. Legg, J.M. Haber, and J.H. Wiggins, 1985, New lifeline multi-scenario seismic risk techniques with a model application. *Civil Engineering Systems*, v. 2, p. 77-83.

Legg, M.R., 19886, Earthquake epicenters and selected fault plane solutions of the mid-southern California continental margin. Map No. 2B in Greene, H.G., and M.P. Kennedy, editors, *Geologic Map Series of the California Continental Margin*, California Division of Mines and Geology, Area 2 of 7, (NOS 1206N-15), Scale 1:250,000.

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Legg, M.R., and J.M. Haber, 1990, Seismic response of sonic boom-coupled Rayleigh waves: *Final Report, U.S. Air Force Systems Command, Noise and Sonic Boom Impact Technology*, OLACHSD/YAH(NSBIT), 246 pp.

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Legg, M.R., 1992, Faulting and seismotectonics in the inner borderland offshore of the Los Angeles Basin in *Proceedings of the Association of Engineering Geologists Annual Meeting, Long Beach, California*, p. 569-578.

Legg, M.R., 1994, Submarine geology of the inner California Continental Borderland of northern Baja California, Mexico. *Geological Society of America Map and Chart Series.* Scale 1:100,000 (in review).

## California State Division of Mines and Geology News

# Local Preliminary Seismic Hazard Zone Maps out for Review

**CDMG Maps on the Web:**
***www. consrv.ca.gov/dmg/shezp***

**The latest tool to help protect life and property during an earthquake is in the works, thanks to the California Department of Conservation. The department has just distributed six preliminary seismic hazard zone maps and draft map guidelines to local officials for technical review.**

### What the Maps Show

The maps show areas in portions of San Francisco, Los Angeles, Orange and Ventura counties that during an earthquake are likely to be susceptible to landslides and/or to water-saturated ground failure known as liquefaction.

The first set of preliminary maps encompass 17 communities including the northern half of San Francisco and Southern California, Simi Valley, the Western portion of Santa Monica and an area from Fullerton and Buena Park south to Newport Beach. Each of the six maps is a 7-1/2 minute quadrangle, covering approximately 60 square miles at a scale of one inch equals 2,000 feet.

### Future Maps

Subsequent sets of preliminary maps for portions of Los Angeles, Orange and Ventura counties will be distributed for review approximately every six months until the currently funded total of 38 maps are produced. The mapping was completed in cooperation with the Governor's Office of Emergency Services and the Federal Emergency Management Agency.

Local governments and other interested parties now have until January 7, 1997 to review and comment on the maps and guidelines. Once the maps are made official in March 1997, the Seismic Hazards Act of 1990 requires local governments use them to identify areas where geologic or soils investigation are required before permitting urban development. The guidelines will help guide cities, counties and consulting engineers and geologists in the investigation and mitigation of these types of hazards inside and outside the mapped areas.

"These maps identify areas having an increased likelihood of liquefaction and earthquake-triggered landslides occurring," said Charles Real, supervising geologist, department of Conservation, at a briefing held for local media. "However, we're not saying the seismic hazards will necessarily occur."

### Where to Find the Maps

The preliminary Seismic Hazard Zone Maps are available to interested parties for review at cost through two reprographic services. For details, call the Department of Conservation Public Information Offices: Los Angeles (213) 620-3560; San Francisco, (415) 904-7707; or Sacramento (916) 445-5716. Copies of the draft guidelines, a geographic index of the maps released for review and other related information are also available through the Department of conservation web site:

***www. consrv.ca.gov/dmg/shezp***

Comments from interested parties or organizations must be submitted to the State Mining and Geology Board by January 7, 1997.

The six preliminary seismic hazard zone maps released include these cities or portions of cities: the northern half of San Francisco and in southern California, Anaheim, Buena park, Costa Mesa, Fountain Valley, Fullerton, Garden Grove, Huntington Beach, Moor Park, Newport Beach, Orange, Placentia, Santa Ana, Santa Monica, Simi Valley, Stanton and Westminster.

The California Department of Conservation has one of the oldest geological surveys in the United States in its Division of Mines and Geology. An integral part of the survey's purpose is to prevent or minimize injury, death and property damage from geologic hazards. The department also safeguards farmland; oversees oil, gas and geothermal wells; regulates mining; studies earthquakes and landslides; promotes beverage container recycling; and manages California's earth resources. ♦

*Ted Smith*
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# More SCEC Scientists' Publications

**The complete SCEC scientists' publications listing is updated and available on a continuous basis. Please contact the SCEC Administrative Office, 213/740-1560, to obtain updated listings from Mark Benthien. Selected publications may be available through a cooperative agreement between SCEC and the NISEE-Caltech Library. The Spring quarterly newsletter includes all publications; subsequent issues include newly submitted papers only. Please see Page 11 of this SQN for more information on submitting papers for SCEC numbers.**

341. Song, X. and D. V. Helmberger, The Northridge Aftershocks, a Source Study with TERRAscope Data, *Geophysical Journal International*, submitted, 1996.

342. Kerkela, S. and J. Stock, Compression Directions North of the San Fernando Valley Determined from Borehole Breakouts, *Geophysical Research Letters*, accepted, 1996.

343. Brocher, T., R. Clayton, K. Klitgord, R. Bohannon, R. Sliter, J. McRaney, J. Gardner and J. Keene, Multichannel seismic-reflection profiling on the R/V Maurice Ewing during the Los Angeles Region Seismic Experiment (LARSE), California, USGS *Open File Report 95-228*, 1995.

344. Murphy J., G. S. Fuis, T. Ryberg, D. Okaya, M. L. Benthien,.M. Alvarez, I. Asudeh, W. Kohler, G. Glassmoyer, M. C. Robertson, and J. Bhowmik, Report for the explosion data acquired in the Los Angeles Region Seismic Experiment (LARSE), Los Angeles, California, USGS *Open File Report xx-xx*, in preparation, 1996.

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347. ten Brink, U., G. Miller, T. Brocher, and D. Foster, Los Angeles Region Seismic Experiment - Offshore seismic refraction data, USGS *Open File Report 96-27*, 1996.

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349. Harris, R. A. and S. M. Day, Effects of a Low-Velocity Zone on a Dynamic Rupture, *Bulletin of the Seismological Society of America*, submitted, 1996.

350. Andrews, D. J. and Y. Ben-Zion, Wrinkle-Like Slip Pulse on a Fault Between Different Materials, *Journal of Geophysical Research*, accepted, 1996.

351. Gao, S., H. Liu, P. M. Davis, L. Knopoff, and G. S. Fuis, A 98-station Seismic Array to Record Aftershocks of the 1994 Northridge Earthquake, USGS *Open-file Report 96-xxx*, submitted, 1996.

352. Kohler, M. D. and P. M. Davis, Crustal Thickness Variations in Southern California from Los Angeles Region Seismic Experiment (LARSE) Passive Phase Teleseismic Travel Times, submitted to *Bulletin of Seismological Society of America*, 1996.

353. Kohler, M. D., J. E. Vidale and P. M. Davis, Complex Scattering Within D" Observed on the Very Dense Los Angeles Region Seismic Experiment Passive Array, submitted to *Geophysical Research Letters*, 1996.

## SCEC and Caltech's EERL NISEE Library Agreement

Through a Memorandum of Agreement with SCEC, **the Earthquake Engineering Research Library (EERL)** of the **Caltech National Information Service for Earthquake Engineering (NISEE)** serves as the point of contact and services to the community at large for earthquake engineering information requests funneled through the Southern California Earthquake Center.

The EERL will accept orders as appropriate for SCEC materials, and forward orders via email for SCEC personnel. For more information, contact:

Mark Benthien
SCEC Outreach Specialist
*ScecInfo@usc.edu*
213/740-1560

## Educating the Public About Earthquake Hazards and Risk: An IASPEI General Assembly Workshop Announcement

**The 29th General Assembly of the International Association of Seismology and Physics of the Earth's Interior (IASPEI) will be held in Thessaloniki, Greece, August 18-28, 1997. The purpose of the Assembly is to give the opportunity to scientists from different disciplines to meet and exchange ideas about present-day problems of the seismological community.**

The program will include a workshop on "Educating the Public About Earthquake Hazards and Risk," with Jill Andrews, SCEC Knowledge Transfer Director, and Dr. K. Ioannides (Greece) acting as co-conveners. The call for papers will be issued later in the fall, but if you are interested in participating, please contact Jill Andrews for further information at:

SCEC Knowledge Transfer
University of Southern California
Los Angeles, California, USA 90089-0742
email: *jandrews@coda.usc.edu*

The following is a description that will appear in the call for papers:

Session #W9(W15a): *Educating the Public About Earthquake Hazards and Risk*

Scope: This session will consist of an opening lecture/presentation on Earthquake Education and Information Dissemination (What is it? Why is it important? How do you do it? What are the benefits?); followed by short presentations by several volunteers who have successful ongoing outreach programs; and finally, formation into small breakout groups to discuss a list of education-information-related topics.

We seek input from participants who have experience with, or interest in, local earthquake response plans; cultural influences on earthquake education, preparedness, and/or response issues; identification of and interaction with specific target groups in both urban and agrarian communities; recruitment of community volunteers to aid in dissemination of earthquake education, awareness, and preparedness; building of mutual beneficial relationships among academic, government, and industry leaders to cultivate community support; use of available aids for information acquisition such as the Internet; publications; achived data resources; and other earthquake education programs.

## Environmental Risk Companies that use GIS

**Our readers sometimes ask for information on environmental risk mapping companies that use GIS. Here is a partial list:**

Risk Management Solutions (RMS)
Hazard/GIS Mapping for Insurance Purposes
149 Commonwealth Dr.
Menlo Park, CA 94025
Tel: (415) 617-6500
FAX: (415) 617-6565
URL: *http://www.riskinc/com*

EQE International, Inc.
Risk/Safety Engineers - GIS
18101 Von Karman Ave., Ste. 400
Irvine, CA 92715
Tel: (714) 833-3303
FAZ: (714) 833-3391
URL: *http://www.eqe.com/*

JHK & Associates
Transportation Systems Consultants
3500 Parkway Lane, Ste. 600
Norcross, GA 30092
Tel: (770) 447-6831
FAX: (770) 449-7268
URL: *http://www.jhk.com*

Harvard Design & Mapping, Co.
Computer Mapping & GIS Consultants
30 Spinelli Place
Cambridge, MA 02138-1046
Tel: (617) 354-0100
URL: *http://www.hdm.com*

Dames & Moore, Inc.
Environmental & Engineering Services
911 Wilshire Blvd., Ste. 700
Los Angeles, CA 90017
Tel: 213-683-1560
Fax: 213-628-0015
URL: *http://www.dames.com*

Claritas (bought Strategic Mapping, Inc.)
Developers of Catalyst GIS+, Atlas GIS
53 Brown Road
Ithaca, NY 14850
Tel: 800/876-6732 x2235
FAX: 607/266-0425
URL: *http://www.claritas.com*

Public Technology Inc.
1301 Pennsylvania Ave. NW, Ste. 800
Washington DC, USA 20004
Tel: (800) 852-4934
FAX: (202) 626-2498
URL: *http://pti.nw.dc.us*

Geo InSight International, Inc.
GIS/Mapping Consulting Firm
2800 Woodlawn Dr., Ste. 253
Honolulu, HI, 96822
Tel: (808) 539-3807
FAX: (808) 539-3810

# Science Seminar News

1.

3.

Clockwise from top right:

1. Sue Hough (USGS), Leon Teng (USC), Yehuda Ben-Zion (USC), Yan Kagan (UCLA), and Heidi Houston (UCLA).

2. Norm Abrahamson and David Jackson.

3. Hong Liu, UCLA, was a featured speaker.

2.

**The first SCEC Science Seminar of the Fall Season was held at U.C. Los Angeles from on Thursday, September 19. The topic was "Modeling Ground Motion from Local Earthquakes." The following questions were addressed:**

**How well we can presently match observed seismograms?**

**How adequate are available models of source complexity, propagation velocity, and site effects?**

**How well can source, path, and site effects be distinguished from one another?**

**How coherent is the wave field as a function of frequency at the surface and at the base of the soil?**

**What improvements in observational capabilities will most effectively improve our abilities to predict ground motion in the near future?**

**The next Science Seminar is October 17, hosted by USC. Subject will be "Progress Report on the Database of Fault Parameters."**

**USGS News**

# SCEC to Host U.S.-Japan Natural Resources Panel on Earthquake Research

**The Southern California Earthquake Center will host the Tenth Biennial meeting of the U.S.-Japan Natural Resources Panel on Earthquake Research (UJNR), in Los Angeles, California, November 12-14, 1996. By virtue of protocol, the meeting is by invitation only. Research reports and summaries will be presented by representatives and research scientists of agencies on both sides of the Pacific. The principal theme of the meeting will be "U.S.-Japan Partnership in Earthquake Disaster Mitigation Research," and will build on the recently agreed upon Earthquake Disaster Mitigation Partnership between our two countries as a part of the Common Agenda for Cooperation in Global Perspective recently signed by President William J. Clinton and Prime Minister Ryutaro Hashimoto.**

This UJNR panel is the primary government-to-government connection between researchers in the U.S. and their counterparts in the science and technology agencies in Japan for a broad spectrum of earthquake-related activities. The U.S. panel will play a central role in the formulation and implementation of the Earthquake Disaster Mitigation Partnership. In the next issue of SQN, we will highlight the proceedings of the meeting and provide more information on the Earthquake Disaster Mitigation Partnership.

**Session Topics**

*GPS/SAR*
— New space technologies for evaluating earthquake potential
— Continuous GPS array in southern California
— Modeling of velocity field in southern California
— Using SAR for observing crustal strain

*STRONG GROUND MOTION*
— New observations and methodologies for predicting strong shaking
— 3-D wave propagation in LA basin
— Focusing effects in LA basin
— Character of ground motions from large earthquakes in LA
— Phase III time history scenarios

*URBAN SEISMIC HAZARDS*
— Faulting and Seismic Potential in LA Basin
— Mechanics of thrust faulting in LA basin — the thick skin model
— Mechanics of thrust faulting in LA basin — an alternative model
— Integrated approach to seismic hazard analysis

*STRATEGIES FOR COOPERATIVE PROJECTS UNDER THE COMMON AGENDA*
— Time-dependent stress transfer
— The 1700 Pacific NW earthquake and tsunami
— Fault-zone drilling
— Realtime Seismology
— Coordination of emergency response

**An urban earthquake hazards field trip also will be scheduled.**

## Northridge Earthquake Reveals Lessons for Modern Cities

The US Geological Survey (USGS) has just released a summary report on the January 1994 Northridge, California, earthquake. The report, *USGS Response to an Urban Earthquake -- Northridge '94,* includes the findings of approximately 100 scientific and engineering investigators, and describes activities of the USGS and many other governmental agencies and private companies in the immediate aftermath of the earthquake and during ensuing work through early 1996.

The report describes the roles and actions of the USGS, its cooperators, and other entities in response to the earthquake, the earthquake's setting and impacts, ground response, ground failures and landslides, structural damage to buildings and freeways, seismic hazards assessments for the future, methods of communicating scientific information, and policies and plans for seismic safety.

Electronic versions of the report are currently available as Portable Document Format (PDF) and HyperText Markup Language (HTML) files on the World Wide Web at the following URL:

*http://geohazards.cr.usgs.gov/northridge/*

# Geophysicists Use T3D to Revise Plate Tectonics Theory

**Berkeley, Calif.** — In an article from the Public Information Office of the University of California at Berkeley, Robert Sanders recently reported that two UCB geophysicists have used a Los Alamos T3D to solve a long-standing problem in geology: why the Earth's crustal plates are so large.

Theories of fluid heating and convection say the surface should be broken into pieces no larger than about 3,000 kilometers across. Instead, the plates are much larger. For example, the Pacific plate covers nearly 13,000 kilometers at its widest. The scientists found that if one assumes that the viscosity of hot rock in the Earth's interior increases by a factor of 30 from top to bottom, then simulated convective flow allows the tectonic plates to conform to their observed dimensions.

"This is a fundamental discovery of fluid dynamics which brings us very close to solving a major problem of geodynamics," observed Mark Richards, professor of geophysics at the University of California at Berkeley, in Sanders' article.

For the results to be noted, the geophysicists monopolized 64 nodes of the Los Alamos National Laboratories' T3D for nearly three weeks in a 3-D simulation of Earth's mantle, which underlies the surface crust or lithosphere and extends approximately 2,700 kilometers down. Richards and UC Berkeley graduate student Hans-Peter Bunge will detail the procedure in an article scheduled for publication in the Oct. 1 issue of *Geophysical Research Letters*. They previously described a more idealized model in the Feb. 8, 1996, issue of *Nature.*

"Until now the explanation has been that the plates are stiff and have high strength, so they make big rafts that only sink in a few places," Richards commented to Sanders. "We've turned that whole argument on its head. If you try to model that, it doesn't really work out."

But by radically simplifying the model of Earth's interior to include only viscosity, the problem was cracked. This effect has only recently been established from seismic reflection studies, Richards noted. The researchers also assumed that viscosity jumps rapidly at a depth of approximately 660 kilometers. Bunge's simulation was based on an earlier model by postdoctoral fellow John Baumgardner. "Assuming a 30-times increase in viscosity causes a dramatic change over what you get when you assume a uniform viscosity in the mantle," he commented to Sanders. "Instead of isolated point-like cold blobs dropping into the interior, the pattern changes to long, linear structures sliding into the interior that look like subduction zones. This tells us that what we see is more related to the deep mantle than to the plates."

"Once we included the effects of changing viscosity, we got pretty much the Earth," Richards said. "The deep mantle is perfectly happy with that scale of convection, and the surface plates follow the convecting system in the mantle, rather than vice versa. The amazing thing is that such a simple effect, a viscosity contrast between the upper and lower mantle, has such profound influence on what we find at the surface. The size of the continents is governed by this effect and not by the structure and stickiness of the plates."

The model also explains the stability of the Earth's hotspots such as the Hawaiian and Reunion Islands, Yellowstone, and Iceland. These upwellings are rooted solidly in the very viscous deep mantle, near where it borders the core, and can't move.

Bunge and Richards plan to improve their model so that it reflects even more of the details of the Earth's interior. Bunge is also developing a way to calculate the model using a cluster of workstations, rather than using expensive supercomputing resources. The work was supported by a grant from National Science Foundation and by the Institute of Geophysics and Planetary Physics at Los Alamos. Computer time was provided by the Advanced Computing Laboratory at LANL. ♦



*Rahul Bahadur*
*(bahadur@earth.usc.edu)*

# Palos Verdes Fault Book to be Released

Tom Henyey, Center Director, with SCEC scientist and San Diego State University professor Tom Rockwell, will lead a group of SCEC affiliates on a field trip to examine the Palos Verdes fault on October 25, 1996. Michael Forrest, SQN Associate Editor, has compiled another provocative book to describe the trip. This version will feature a specific guide, with maps, to provide readers with the information necessary to conduct their own trip.

The book will cover the character and seismicity of the Palos Verdes fault, and the fault zone origins. The field guide will feature stops along the winding road to Malaga Cove, with intriguing information about the structure of the fault and the history of fault movement. A chapter on the Los Angeles Harbor will be included since the trip features a yacht tour of the Harbor.

The book is due for printing in mid-November. *For information on how to obtain a copy, please contact SCEC Knowledge Transfer:*

*Mark Benthien*
*Outreach Specialist*
*tel 213/740-1560*
*fax 213/740-0011*
*email: ScecInfo@usc.edu*

# PASSCAL High Resolution Seismic Short Course

PASSCAL is sponsoring a two day short course on high resolution seismic reflection techniques to be given by Don Steeples. The course will be conducted at Stanford on Dec 13-14, 1996. It is designed for Principal Investigators who have little or no experience in this area, but who would like to utilize the new PASSCAL multi-channel reflection acquisition system either on experiments or for class room purposes.

The course will cover the basics of data acquisition and processing and have some limited field work. A comprehensive set of course notes will be available to all attendees. In order to provide the maximum "hands-on" experience, the course will be limited to 20 students. PASSCAL can provide a limited amount of financial support if necessary.

Registration requests should be submitted by filling in the form on the PASSCAL Web site:

*http://www.iris.edu/passcal/course.form.html/*

Priority will be given to faculty and research staff. However, on October 1, any remaining slots will be open to students who have applied. Questions should be addressed to Jim Fowler *(jim@iris.edu)*. ♦

## Earthquake Hazards Reduction Fellowship Announced

Under a cooperative agreement with FEMA, the Earthquake Engineering Research Institute offers the 1997 Professional Fellowship to provide an opportunity for a practicing professional to gain greater skills and broader expertise in earthquake hazards reduction, either by enhancing knowledge in the applicant's own field, or by broadening his or her knowledge in a related, but unfamiliar discipline. The fellowship provides a stipend of $30,000, commencing January 1997, to cover tuition, fees, relocation and living expenses for a six-month period. Applicants must provide a detailed work plan for a research project that would be carried out in the six-month period. Candidates may obtain an application form from:

EERI
499 14th Street, Suite 320
Oakland, CA 94612-1934
Telephone: 510/451-0905
Fax: 510/451-5411
e-mail: *eeri@eeri.org*

## National Disaster Medical System Conference Scheduled

The National Disaster Medical System (NDMS) is sponsoring its annual 1997 conference in Tampa, Florida. The main conference will be held May 5 - 7 and the pre-conference courses will be conducted May 3 - 4, 1997.

The Conference will focus on delivering health and medical services in catastrophic disasters and will be held at the Hyatt Regency at Tampa City Center, in Tampa, Florida. For additional information, please contact NDMS on 1-800-USA-NDMS, extension 444.

The Conference will feature tracks focusing on the following issues:

Public Health
Planning, Management and Coordination
Clinical Medicine
Field Response, and
Health Care Facilities.

The following training courses will be offered prior to and during the conference: Communications, Mass Fatalities, Mass Casualty, Moulage, Exercise Design and Incident Command System (ICS). Full accreditation for continuing education is anticipated for these courses and the main conference.

## SQN Seeks Contributions from Scientists

The SCEC Quarterly Newsletter seeks contributions from SCEC researchers. Short summaries of current work in progress by researchers in the eight SCEC working groups will be published each issue. Please follow these guidelines:

Your contribution must be a project which falls into one of the eight working groups:

Group A, Master Model: David Jackson, group leader
Group B, Ground Motion Modeling: Steve Day, group leader
Group C, Earthquake Geology: Kerry Sieh, group leader
Group D, Subsurface Imaging and Tectonics: Rob Clayton, group leader
Group E, Crustal Deformation: Ken Hudnut, group leader
Group F, Regional Seismicity and Source Processes: Egill Hauksson, group leader
Group G, Physics of the Earthquake Source: Leon Knopoff, group leader
Group H: Engineering Applications: Geoff Martin, group leader

The length of the article should be about 500-750 words of text, written at a 4-year (Bachelor's) college degree level. If you use technical phrases or jargon, please include brief definitions. (Although our readers are well-educated experts, they are likely not up to speed in your earth-science or engineering-related field. Definitions help.) The text should cover a description of your research project and how it fits with the working group's goals; names of principal investigators, post-docs, graduate or undergraduate students; and the important findings. If you would like to include figures, graphs, or photos, we can incorporate them into the article. We can either scan in original figures or photos, or receive them from you via the Internet. For information on how to best transfer your figures or photos, contact Mark Benthien at *ScecInfo.usc.edu.*

Please email your contributions to:
*jandrews@coda.usc.edu*

## IDNDR Internet Conference: Solutions for Cities at Risk to Disasters, 26 August - 25 October 1996

The internet conference was part of the 1996 public awareness campaign, Cities at Risk, organized by the United Nations Secretariat for the International Decade for Natural Disaster Reduction, and implemented jointly with many organizations around the world. In August, 1996, IDNDR announced its Internet Conference. The following is a summary of the purpose and content of the conference, and information on how you can access the results.

The IDNDR Internet Conference on Solutions to Cities at Risk was a forum for debate. In this conference, participants learned what communities around the world are doing to protect themselves from disasters; asked questions to those directly involved in city programs, to see how their activities could be adapted; presented urban disaster mitigation experiences for discussion and feedback; consulted experts in many different professions about disaster mitigation issues.

Conference proceedings will be published as a "Solutions for Cities at Risk" publication in 1997 (pending sponsorship). Organizers of the Conference were the United Nations - International Decade for Natural Disaster Reduction (IDNDR) Secretariat and the IDNDR Regional Office, Latin America/Caribbean.

The Host was QUIPUNET, an NGO which promotes education via the Internet. QUIPUNET was host of recent Internet conference on Kobe Earthquake and its lessons. The conference address on the World Wide Web: *http://www.quipu.net/risk/*

Participants included city administrators, National IDNDR Committees, UN specialised agencies, inter-governmental and non-governmental agencies, scientific organizations, universities, national ministries, and the private sector.

Campaign materials to carry out local activities are available:

- Publication: Cities at Risk (40pp, English, Spanish, French, Italian)
- Poster: Making Cities Safer (English, Spanish, French, Italian)
- Flyer: International Poster Contest (English, Spanish, French)
- Flyer: Guidelines for Local Organizers (English, Spanish, French)
- Flyer: Facts and Figures (English, Spanish, French)
- Flyer: Activities for Children flyer (English, Spanish, French)
- Booklet for children: Learning about Natural Disasters (English, Spanish, Italian, French, Russian, Chinese, Hindi, Farsi, Macedonian) ($2.50/copy)
- Stop Disasters Magazine (English, Spanish, French, Italian; abbreviated versions in Chinese and Russian)

For more information, contact:

International Decade for Natural Disaster Reduction (IDNDR) Secretariat
UN Department of Humanitarian Affairs
Palais des Nations
1211 Geneva 10
Switzerland
Tel: (41 22) 798 6894, Fax: (41 22) 733 8695
E-mail: *idndr@dha.unicc.org*

Quipunet Home Page: *http:// www.quipu.net*

IDNDR Home Page: *http://hoshi.cic.sfu.ca/hazard/idndr.html*

# *EQIP Establishes EQNET Home Page and Web Site*

The Earthquake Information Providers' Group (EQIP, pronounced "equip") now has a Web site under construction. Called "EQNET" (Earthquake Hazards Mitigation Information Network), the site links to 43 sites featuring resources related to earthquake hazards mitigation. Check out:

***http://www.eqnet.org***

The page has an alphabetic listing of information sources (linked); information sources by subject; bibliographic resources (indexes, libraries, etc.); images, multimedia and computer software providers; and a page which describes the mission of the EQNET Web site working group.

The working group, comprised of volunteer Earthquake Hazard Mitigation Information Providers, has created the home page and site and will endeavor to assist the community of earthquake information providers with Web-related support.

Members of the EQNET working group include:

Patricia Coty, Chair (NCEER)
Jill Andrews (SCEC)
Clifford Astill (NSF)
Jim Buika (FEMA Region IX)
Dave Butler (NHRAIC)
Karen Gahagan (IIPLR)
Steve Ganz (WSSPC)
Lind Gee (UCBSS)
Chuck James (UCB-EERC)
Scott McAfee (OES)
Dick McCarthy (CSSC)
Sarah Nathe (OES)
Chris Rojahn (ATC)
Doroty Tao (NCEER)
Jeanette Zerneke (UCB)

# Calendar

**October, 1996**

**17** SCEC Science Seminar, "Progress Report on the Database of Fault Parameters," 1pm - 5pm, Crowne Plaza Hotel, Los Angeles. For more information, contact *scecinfo@usc.edu*.

**20-22** SCEC Annual Meeting, Palm Springs, California. Call 213/740-5843 for more information.

**20-22** Association of Contingency Planners (ACP) National Symposium, San Antonio, Texas. Call 512/463-3950 and ask for Tommye White for more information.

**25** SCEC-Sponsored field trip with Dr. Tom Henyey, SCEC Director, and Dr. Tom Rockwell, San Diego State University. We will spend the day inspecting the Palos Verdes Fault zone. The trip is full but we'll be scheduling a duplicate trip in February, 1997. Stay tuned!

**28-31** Geological Society of America (GSA) Annual Meeting, Denver, Colorado. Meeting will include sessions on seismicity of North America and on numerous other geologic hazards. Contact: GSA, 3300 Penrose Place, Boulder, CO 80301; 303/447-2020; 800/472-1988.

**30-31** A Two-Day Workshop: Exploring Options for Seismic Zonation in the City of Los Angeles. Co-sponsored by the City of Los Angeles, CDMG and SCEC. Call 213/740-1560 for more information.

**November, 1996**

**5-7** 3rd US-Japan Conference on Corporate Earthquake Programs, San Jose, CA. Information: Steven Vukazich, 408/924-3858, fax 408/924-4004, e-mail: *vukazich@isc.sjsu.edu.*

**12-14** Tenth U.S.-Japan Natural Resources Committee on Earthquake Prediction Technology, by invitation only. Contact: J. Dieterich, USGS, email: *jdieterich@isdmnl.wr.usgs.gov,* or Bill Ellsworth, USGS, email*: ellswrth@andreas.wr.usgs.gov.*

**December, 1996**

**3-5** International Conference and Exposition on Natural Disaster Reduction, American Society of Civil Engineers, Sponsor, Washington, D.C. Contact: Natural Disaster Reduction '96, ASCE, 345 East 47th Street, NY, NY, 10017; 800/548-2723; email: *conf@ny.asce.org*.

**6-7** SCEC-Sponsored Field Trip with Dr. Kerry Sieh. We will inspect the southern San Andreas Fault system. We'll begin in San Bernardino and head south, ending up in Palm Springs. Don't miss this opportunity to learn more about the largest fault in California! Call 213/740-1560 for more information.

**15-19** American Geophysical Union Annual Meeting, San Francisco, CA. Fax 202/328-0566; email: *mvanblack@kosmos.agu.org*

**January, 1997**

**15-17** Fifth U.S./Japan Workshop on Urban Earthquake Hazard Reduction. Sponsored by EERI and Japan Institute of Social Safety Science (ISSS). Los Angeles, CA. "Recovery and Reconstruction from Recent Earthquakes: Implications for Urban Earthquake Hazard Reduction." Contact EERI, phone 510/451-0905; fax 510/451-5411.

**February, 1997**

**20** SCEC Science Seminar, Caltech. Subject to be announced.

**March, 1997**

**20** SCEC Science Seminar, U.C. San Diego. Subject to be announced.

**April, 1997**

**9-11** Seismological Society of America 92nd Annual Meeting, Honolulu, HI. Contact: email *ssa7@ginger.bachman.hawaii.edu* or WWW: *http://www.soest.hawaii.edu/ssa97.html*

**17** SCEC Science Seminar, U.C. Los Angeles. Subject to be announced.

**POSTPONED UNTIL FURTHER NOTICE:** SCEC Annual media workshop, "Earthquakes and the Media." Goal of the workshop is to identify needs of radio, television, print and wire representatives in the context of SCEC's capabilities. Call 213/740-1560 for more information.

# Earthquake Information Resources On Line

## SCEC Data Center Pages

**Current Southern California Seismic Network (SCSN) Weekly Earthquake Reports:**
*http://www.scecdc.scec.org/earthquakes/current.txt (text)*
*http://www.scecdc.scec.org/earthquakes/current.gif (map)*

**SCSN Weekly Earthquake Reports back to January 1993:**
*http://scec.gps.caltech.edu/ftp/ca.earthquakes*

**Caltech/USGS Seismocam: Waveform displays of data only 30 seconds old:**
*http://scec.gps.caltech.edu/seismocam/*

**Earthquakes in Southern California:**
Includes aftershock maps, animations of aftershock sequences and rupture models, and a clickable map of historic Southern California earthquakes and Los Angeles Basin earthquakes. Main Page:
*http://www.scecdc.scec.org/eqsocal.html*

**Southern California Clickable earthquake map:**
*http://www.scecdc.scec.org/clickmap.html*

**Los Angeles Basin Clickable earthquake map:**
*http://www.scecdc.scec.org/laseiskiosk.html*

**LARSE home page:**
*http://www.scecdc.scec.org/larse.html*

**USGS OFR 96-85, Data Report for 1993 Los Angeles Region Seismic Experiment, Southern California: A Passive Study from Seal Beach Northeastward through the Mojave Desert.**
*http://www.scecdc.scec.org/larse/93title.html*

**USGS OFR 95-228, Multichannel Seismic-Reflection Profiling of the R/V Maurice Ewing During the Los Angeles Region Seismic Experiment (LARSE), California.**
*http://www.scecdc.scec.org/larse/LMtitle.html*

USGS Response to an Urban Earthquake -- Northridge '94, electronic version:
*http://geohazards.cr.usgs.gov/northridge/*

## Up-to-the-minute Southern California Earthquake Map:

This site takes the earthquake locations broadcast via e-mail from Caltech and makes a map of the last approximately 500 earthquakes. It is automatically updated and works for Java-enabled browsers only.

*http://www.crustal.ucsb.edu/scec/webquakes/*

## Understanding Earthquakes

A general interest site that includes an earthquake quiz, a rotating globe showing earthquake locations, famous accounts of earthquakes, and similar features.

*http://www.crustal.ucsb.edu/~grant/understanding/*

## Santa Barbara Earthquake History

Historical accounts and photographs relating to earthquakes that have affected Santa Barbara County, California.

*http://www.crustal.ucsb.edu/~grant/sb_eqs/*

**For further information, contact the author:**
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Institute for Crustal Studies
University of California
Santa Barbara CA 93106-1100
*grant@quake.crustal.ucsb.edu*
fax 805-893-8649
tel 805-893-8437

## The Nevada Seismological Laboratory

*http://www.seismo.unr.edu*

This site offers information on current earthquakes and its research and teaching programs. Users can access lists, maps, and seismogram data from the latest earthquakes, and can report any events they have felt. There are background geologic and seismicity maps, and on-line searching of earthquake catalogs. General information is available on-line in contact lists, brochures, geophysics degree program information for students, and courses in earthquake fundamentals and scientific visualization.

John Louie
*(louie@seismo.unr.edu)*

***See "On Line Resources"*** *on Page 31*

# Earthquake Information Resources On Line, cont.

## SCEC World Wide Web Home Page

**SCEC WWW URL**
*http://www.usc.edu/go/scec*

## SCEC Volunteer Needed to Aid the "Ask a Scientist" Project

A new web site is under construction. It is called "Ask a Scientist," and will provide email contact to K-12 teachers and students with scientists from all disciplines. The Humboldt County Office of Education is developing the web site "to assist K-12 students and teachers in locating quality science resources on the internet." This is the science portion of a project funded by the California County Superintendents Educational Services Association and has been given the name "Schools of California Online Resources in Education," or S.C.O.R.E.

The site is located at: *http://intergate.humboldt.k12.ca.us/score/*

Scientists interested in participating should contact Dan Scofield at: *scofield1@llnl.gov*

Requests and questions from high school students appear on a regular basis on many scientists' email. To provide a mechanism for sharing the load, SQN would like to hear from any volunteers who could perform as a SCEC intermediary, whose function is to screen requests, possibly guide students or and to appropriately direct them to sources of information. If you are interested, please contact:

Mark Benthien
SCEC Outreach Specialist and Webmaster
*ScecInfo@usc.edu*

*SQN Ed.*

## SCEC on the Internet

**SCEC Knowledge Transfer and Education Programs are reachable via electronic mail.**

**Ask general questions, make requests, send us information for use in our resource center or for consideration for publishing in the next newsletter.**

***ScecInfo@usc.edu***

## Other WWW Sites for Exploration

### EQNET
***http://www.eqnet.org/***

### Recent Quakes (with a great map viewer)
***http://www.civeng.carleton.ca/cgi-bin/quakes***

### Annual Southern California Network Bulletins from 1991 - Present
The bulletins are now available on the Web (minus the figures). They describe the activities of the USGS Pasadena Field Office and include a summary of annual seismicity and a list of magnitude 3.0+ events each year. Contact Lisa Wald, USGS Pasadena, e-mail *lisa@usgs.gov* for information.

***http://aladdin.gps.caltech.edu/lisa/NETBULLS/netbull_list.html***

### USGS Web Sites with Earthquake Information and More

**General USGS site:** ***http://www.usgs.gov***
**National Earthquake Information Center:** ***http://gldss7.cr.usgs.gov/***
**Earthquake Information:** ***http://geology.usgs.gov/quake.html***
**USGS Menlo Park:** ***http://quake.wr.usgs.gov/***
**USGS Pasadena:** ***http://www-socal.wr.usgs.gov***

### The Council of the National Seismic System Merged Earthquake Databases
The databases can be tracked down with hypertext jumps through two Web sites:

***http://www.geophys.washington.edu/cnss.cat.html***
and
***http://quake.geo.berkeley.edu:80/cnss***

The first address has a very long current catalog that is hard to read, but prints out fairly legibly.

*Jack Popejoy, KFWB News Radio 98*

## Southern California Earthquake Center Administration

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**Administration - John McRaney**
**Education - Curt Abdouch**
**Knowledge Transfer - Jill Andrews**
**Outreach Specialist - Mark Benthien**
**Administrative Ass't - Sue Turnbow**

## SCEC Board of Directors



## World Wide Web: Geodetic Information

GPS Time Series and SCIGN Map:
*http://sideshow.jpl.nasa.gov/mbh/series.html*

SCEC Data Center Geodetic Information:
*http://www.scecdc.scec.org/scign*

JPL Web Site: *http://milhouse.jpl.nasa.gov/*

## KFWB Radio Webservice:

This site features an earthquake page and links to the SCEC Home Pages and to the SCEC Data Center: *http://kfwb.com*

The earthquake button leads you to:
*http://kfwb.com/eqpage.html*

**The SCEC Portable Broadband Infrastructure Center and other geophysics and earthquake information sites with links:**

*http://www.crustal.ucsb.edu/scec/pbic*
*http://www.crustal.ucsb.edu/scec/smdb*
*www.crustal.ucsb.edu*

For more information, contact:
Aaron J. Martin*(aaron@quake.crustal.ucsb.edu)*

## Seismo-surfing the Internet

***http://www.geophys.washington.edu/seismosurfing.html***

## To Subscribe to the SCEC Quarterly Newsletter

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## Inside this issue:




**SCEC Quarterly Newsletter**

*SCEC Quarterly Newsletter* (SQN) is published quarterly by the Southern California Earthquake Center, University of Southern California, University Park, Los Angeles, CA 90089-0740, USA, telephone 213/740-1560 or 213/740-5843, fax 213/740-0011, e-mail: *ScecInfo@usc.edu*. Please send requests for subscriptions and address changes to the attention of SQN Editor.

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Photographs and Figures:
Dolan, et al. (p. 13)
M. Forrest (pp. 8, 9, 23)
T. Henyey (p. 2, 4)
M. Legg (pp. 15, 17)
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*Photo and figure enhancement*: Mark Benthien



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