Southern California Earthquake Center

Quarterly Newsletter
Winter 1996

Volume 1, Number 4

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Strong Ground Motion Resulting from Probable Major Earthquakes in Southern California Report Series to be Released

A series of final reports to the California Department of Transportation, the County of Los Angeles and the City of Los Angeles will be delivered in March by the Southern California Earthquake Center. A joint agreement among the participants provided for funding over a three year period (April 1992 to March 1995) for studies related to the improvement of our knowledge and understanding of the nature and characteristics of strong ground motion resulting from probable major earthquakes in southern California, particularly in the greater Los Angeles region.

The project as a whole was divided into nine separate tasks, each with its own Principal Investigators. The Principal Investigators for the overall project were Keiiti Aki (SCEC Science Director) and Geoffrey R. Martin (SCEC Engineering Applications). Each Final Task Report has been published in separate volumes, to be available at replacement cost through the Center Knowledge Transfer Office.

The **Task H-1** report describes the development of improved empirical models for scaling the amplitudes of smooth elastic earthquake response spectra characteristics for the southern California region, for use in design. These empirical scaling equations can be used directly for prediction of site-specific spectral amplitudes given the earthquake magnitude, the distance from the source, and the geological and local soil conditions at a particular site. The equations also improved attenuation rela-

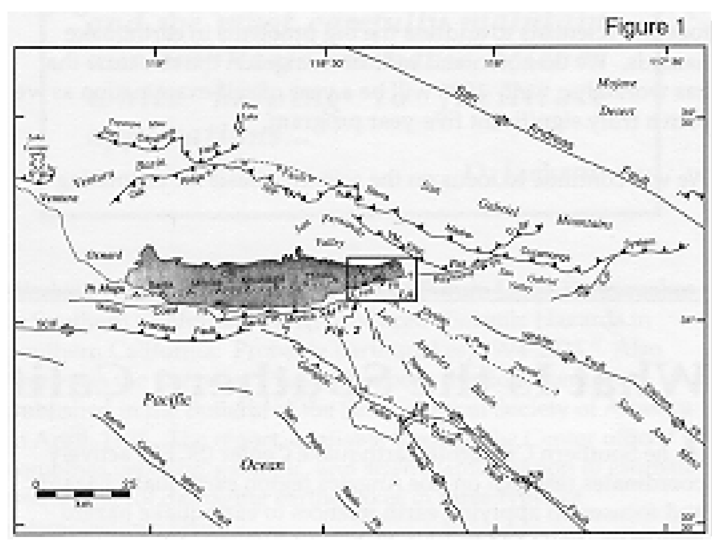

Figure 1, Above: Regional neotectonic map for metropolitan southern California showing major active faults, from Task H-2 by James Dolan and Kerry Sieh. The Hollywood fault is a 14 km-long active fault within the 215 km-long Raymond-Hollywood-Santa Monica-Malibu Coast-Santa Cruz Island-Santa Rosa Island fault system. Closed teeth denote reverse fault surface trace; open teeth on dashed lines show upper edge of blind thrust fault ramps. Strike-slip fault surface traces shown by double arrows. Hol Flt=Hollywood fault; SCIF=Santa Cruz Island fault; RMF=Red Mountain fault; SSF=Santa Susana fault; VM-ERF=Verdugo Mountains-Eagle Rock fault; SJF=San Jose fault; LA=Los Angeles; Pas=Pasadena; SM=Santa Monica; NB=Newport Beach; LB=Long Beach. Dark shading shows Santa Monica Mountains.

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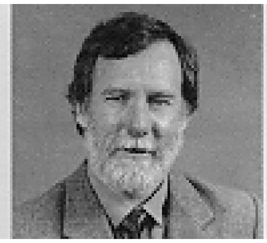
From the Center Directors...

Thomas Henyey
Center Director

David Jackson
Science Director



The Next Five Years at SCEC

Professor Keiiti Aki, the founding father and former Director of the Southern California Earthquake Center, has retired from that post. We owe him a huge debt of gratitude. Tom Henyey as Center Director, and I as Science Director, will now share the responsibility for leading the Center into the next millennium. As Chairman, I will work with the Board of Directors to both establish scientific priorities and express them in specific science plan. In June, 1996, we will propose a five-year extension of Center activities to the National Science Foundation and the U.S. Geological Survey, who have jointly funded the majority of Center projects. Tom will manage the funds and oversee the Education and Outreach program.

By all accounts, the Center has succeeded famously in bringing together scientists to address the big problems in earthquake hazards. We do not intend radical changes in the structure that has worked so well. 1996 will be a year of self-examination as we plan a truly significant five-year program.

We will continue to focus on the scientific basis for estimating earthquake hazards. Our objectives will be to (1) estimate the probabilities of future earthquakes as a function of time, place, and magnitude; (2) predict the resulting seismic motion; and (3) communicate the results to those who can use the information. We'll take special pains to coordinate our activities with the U.S. Geological Survey and the California Division of Mines and Geology, who have statutory responsibilities for earthquake hazard estimation. We'll concentrate on the scientific problems, and let them estimate the actual hazard.

As we look to the future, we must establish even more constructive relationships with the earthquake engineering community and other partners in reducing earthquake risk. Only a coordinated, comprehensive approach can adequately inform those who must make important decisions in the face of relatively rare, but potentially devastating, natural catastrophes.

David Jackson

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. Future work will consider seismic wave path effects and local site conditions for developing a complete seismic hazard assessment of southern California.

For more information, call 213/740-1560 or 213/740-3459.

SCEC Board of Directors Announces New Center Management

The Southern California Earthquake Center Board of Directors recently appointed a new Center Director and a new Science Director, effective February 1, 1996.

Center Director Dr. Thomas L. Henyey, Professor of Geophysics at the University of Southern California, is the former Executive Director for the Center. Henyey's major research interests include fault zone structure/mechanics and crustal structure/tectonics. His Ph.D. work at Caltech and early research at the University of Southern California dealt with the thermomechanics of the San Andreas fault and the thermal regime of southwestern North America. Henyey's most recent research focuses on the application of reflection seismology to crustal structure and evolution in southwestern U.S. He was the Principal Investigator and Coordinator for the CALCRUST consortium, which acquired and processed seismic reflection data from a number of areas in southern California and Arizona. More recently he has been co-principal and principal investigator for proposed geotectonic transects across the Transverse Ranges in southern California and the Southern Alps in New Zealand. After serving in the capacity of SCEC Executive Director for five years under the direction of Dr. Keiiti Aki, who announced his plans for retirement late last year, Dr. Henyey is well prepared to assume his post as Director.

> ***"My hope is that, more and more, Center scientists can be convinced that reaching out can be as rewarding as doing the science."***
>
> **T. Henyey**

As Center Director, Henyey will act as Chief Operating Officer and will serve as an ex-officio non-voting member of the Board. He will serve as the Center's official liaison to all Center constituents, and will maintain day-to-day oversight of the Administrative, Knowledge Transfer, and Education activities.

In making his presentation to the Board, Henyey spoke of his vision for the Center. "SCEC is one of a handful of major earth science consortia in the U.S., and therefore highly visible and

See "Henyey" on Page 6

Science Director Dr. David Jackson, whose degrees are from the California Institute of Technology and Massachusetts Institute of Technology, is a Professor of Geophysics at the University of California, Los Angeles. His research expertise spans probabilistic seismic hazard analysis; statistical data analysis; mathematical inference in geophysics; earthquake prediction; crustal deformation using Global Position Systems; and geophysical exploration. Dr. Jackson served as principal author in coordinating the 1994 Working Group on the Probabilities of Future Large Earthquakes in Southern California, which produced "Seismic Hazards in Southern California: Probable Earthquakes, 1994-2024." Also known as the Center's "Phase II" report, the document was published in the Bulletin of the Seismological Society of America in April, 1995. The report, available through the Center office, combines geodetic, geologic, and seismic information to estimate frequencies of damaging earthquakes in three types of seismotectonic zones.

> ***"We must...ensure that the scientific dialog remains focused and intense, we must continue to provide trustworthy products, and we must carefully maintain our emphasis on basic science while helping to facilitate applications..."***
>
> **D. Jackson**

As Science Director, Dr. Jackson will serve as the Chairman of the Board of Directors, and will have responsibility for the science program of the Center. He will oversee development and implementation of the science plan for the center (in consultation with the Center Director and other Board members and maintain day-to-day oversight of the science activities.

In speaking to the Board on the future of SCEC, Jackson summa-

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Report *continued from Page 1 ...*

tions for use in probabilistic earthquake hazard analyses.

The **Task H-2** report focuses on potential destructive earthquakes in the northern Los Angeles basin. Results of the study have been productive in delineating the location and structural style of the two major faults crossing the area — the Hollywood and Santa Monica faults — and the seismic hazards posed by these faults, which were poorly known prior to the study.

The **Task H-3** report describes a study of the amplification of ground motions arising from the presence of a site specific soil profile. Whereas the empirical equations developed as part of Task H-1 inherently reflect such amplification in a broad sense for generalized site categories, site-specific amplification characteristics with respect to basement rock motion beneath a site are often required. This study examines, in particular, the use of weak motion amplification factors (obtained from coda wave amplitude measurements from microearthquakes) for microzoning, and the relationship between weak and strong motion amplification where the influence of linear versus nonlinear soil response becomes a factor.

The **Task H-4** report describes the development of improved empirical models for scaling the duration of strong ground motion for the southern California region by utilizing regression analyses of recorded data. The developed regression equations describe the duration of strong ground motion in terms of the seismic energy available to excite structures. As all the processes effecting the duration are frequency dependent, analyses of duration have been performed in twelve narrow frequency bands with a central frequency between 0.1 to 25 Hz. These scaling equations can be used for the prediction of site-specific duration of strong ground motion given the earthquake magnitude, the distance from the source, and the geological and local soil conditions at a site.

The **Task H-5** report describes the compilation of a GIS based geotechnical database for southern California (specifically focusing on the Los Angeles Basin) for use in strong ground motion site characterization. Such a database is particularly valuable for assessing site amplification and site stability during strong ground motion. The program, TECHBASE (a mining and

See "Report" *on Page 5*

The Reports

Task H-1 (Volume 1)
Empirical Equations Describing Attenuation of Horizontal Peaks of Strong Ground Motion in Terms of Magnitude, Distance, Path Effects and Site Conditions
by V. W. Lee, M. D. Trifunac, M. F. Todorovska and E. I. Novikova, University of Southern California

Task H-1 (Volume 2)
Frequency Dependent Attenuation Functions and Fourier Amplitude Spectra of Horizontal StrongEarthquake Ground Motion in California
by V. W. Lee and M. D. Trifunac, University of Southern California

Task H-1 (Volume 3)
Pseudo Relative Velocity Spectra of Horizontal Strong Earthquake Ground Motion in California
by V. W. Lee and M. D. Trifunac, University of Southern California

Task H-2
Paleoseismology, Tectonic Geomorphology and Seismic Hazards of the Hollywood and Santa Monica Faults
by James F. Dolan, Department of Earth Sciences, University of Southern California, and Kerry Sieh, California Institute of Technology

Task H-3
Effects of Local Site Characteristics on Ground Accelerations
by K. Aki and B. H. Chin, University of Southern California

Task H-4
Frequency Dependent Duration of Strong Earthquake Ground Motion: Updated Empirical Equations
by E. I. Novikova and M. D. Trifunac, University of Southern California

Task H-5 (Volume 1)
Geotechnical Site Data Base for Southern California
by Mladen Vucetic and Macan Doroudian, University of California, Los Angeles

Task H-5 (Volume 2)
Geotechnical Site Data Base for Southern California: Digitized Boring Logs
by Mladen Vucetic and Macan Doroudian, University of California, Los Angeles

Report *continued from Page 4 ...*

geotechnically oriented three-dimensional GIS software package with capabilities for generating soil and geologic profiles and boring logs) was used as the prime database program. The database includes more than 850 digitized geotechnical boring logs, and also includes digitized maps of major faults and highways.

The **Task H-6** report documents the earthquake performance and damage to bridges in the magnitude 7.8 Luzon, Philippine earthquake (July 1990) and the magnitude 7.5 Costa Rican earthquake (April 1991). In both earthquakes, liquefaction-related ground deformations were responsible for much of the observed damage.

The **Task H-7** report's objectives were to: a) develop a consensus on the methodologies to be used for probabilistic seismic hazard analyses, and b) examine the viability of various physically based methods for generating artificial time histories for given earthquake scenarios. The report demonstrates the seismic hazard analysis methodology with respect to selected sites in the Los Angeles Basin, and illustrates several methods for generating acceleration time histories using selected sites and large magnitude earthquake scenarios. The availability of such time histories is of vital importance for structural earthquake analyses.

The **Task H-8** report describes the use of geotechnical data to reassess and improve the Los Angeles geological data base used to develop liquefaction potential maps. The report also develops a more quantitative approach for assessment of post-liquefaction ground deformation potential suitable for mapping, and illustrates the methodology for a small region in the vicinity of the Port of Los Angeles. This task complements Task H-5 and also utilizes the three-dimensional GIS program, TECHBASE.

The **Task H-9** report focuses on the cataloging of available strong motion records for vertical ground acceleration time histories, together with the computed acceleration response spectra. Comparisons are made between the characteristics of vertical ground motions and those of horizontal ground motions. Vertical ground motion characteristics are receiving more attention for engineering design following the Northridge earthquake. ♦

The Reports

Task H-5 (Volume 3)
Geotechnical Site Data Base for Southern California: Digitized Boring Logs with ShearWave Velocity Estimates from SPT Data
by Mladen Vucetic and Macan Doroudian, University of California, Los Angeles

Task H-6
Evaluation of Bridge Damage in the 1990 Luzon and 1991 Costa Rica Earthquakes
by J. F. Hall and R. F. Scott, California Institute of Technology

Task H-7
Probabilistic Seismic Hazard Analysis and Development of Earthquake Scenario Time-Histories for Southern California Sites
by K. Aki, G. R. Martin, and B. H. Chin, University of Southern California; N. Abrahamson, Consulting Seismologist; A. C. Cornell, Stanford University; and M. Mahdyiar, Vortex Rock Consultants, Inc.

Task H-8
Map Based Characterization of Liquefaction Potential for Southern California
by G. R. Martin and D. C. Andrews, University of Southern California

Task H-9
Characteristics of Vertical Ground Accelerations,
by Ta-liang Teng and Jiang Qu, University of Southern California

The Southern California Earthquake Center gratefully acknowledges the generous financial support of the California Department of Transportation, and the City and County of Los Angeles, which enabled these studies to be undertaken. The Center believes that good progress has been made in fulfilling the original objectives of the nine tasks, but also wishes to emphasize the need for continued investigation in many of the task areas, and for ongoing knowledge transfer to the practicing engineering profession.

Report copies are available on a limited basis for recovery cost. Please contact the Southern California Earthquake Center, 213/740-3459 or 213/7401560 for details on ordering a set of volumes.

Henyey *continued from Page 3 ...*

potentially vulnerable, especially at a time of shrinking national resources for basic research. It is important for the management of the Center to understand [the role of SCEC], and be prepared to take the steps necessary to keep the Center both viable and vibrant. This means emphasizing, in addition to our scientific achievements, the Center's mission...it means opening healthy lines of communication with those that can benefit from the Center's existence. I would like to see the Center reach out to many constituencies to transfer our interactive approach to earthquake hazard assessment nationwide, and ultimately involve a larger segment of the U.S. earthquake scientific communities. My hope is that, more and more, Center scientists can be convinced that reaching out can be as rewarding as doing the science." ♦

"The fact that both Henyey and Jackson have demonstrated an eager willingness to work together as a team has been a most heartwarming aspect of the process of re-inventing SCEC. We owe them! On behalf of the Center administration, Board of Directors and Steering Committee, a hearty welcome to the team of Tom Henyey and Dave Jackson."

...Vice Chairman of the Board Bernard Minster, in a recent communication to the SCEC Steering Committee.

Jackson *continued from Page 3 ...*

rized some of the Center's scientific accomplishments: its phased reports, the studies of blind thrusts beneath Los Angeles Basin, the measurement and interpretation of regional strain using GPS technology; its studies of the Landers and Northridge earthquakes, and the theoretical models of rupture dynamics. "We must, however, ensure that the scientific dialog remains focused and intense, we must continue to provide trustworthy products, and we must carefully maintain our emphasis on basic science while helping to facilitate applications," he said. "Communication, authoritative data and reports, and large scale experiments make SCEC special. Communicating the implications of earthquake research to those with decisions to make is an important part of our responsibility, and the efforts we have made so far in this area have enhanced, rather than detracted from the Center's commitment to basic science." ♦

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:

- Report from the 1995 Research Utilization Council Workshop
- Insurance Industry Workshops; Proceedings; Audio tapes
- Engingeering 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
- SCEC-Sponsored Publications; Scientific Reports

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

Selected SCEC Research Abstracts ...What Are We Studying?

The SCEC Annual Meeting, held in Septemer, 1995, featured presentations and posters with highlights of SCEC-sponsored research projects. We've added this new department as a way of alerting our readers to topics of focused research.

Mapping of the 1994 Northridge Earthquake Fault and the Santa Susana Mountains Anticlinorium, Southern California

T. L. Davis and J. S. Namson
Davis and Namson Consulting Geologists
25600 Rye Canyon Road, Suite A, Valencia, CA 91355

The 1994 Northridge earthquake fault (Pico thrust) and Santa Susana Mountains anticlinorium have been mapped from balanced cross sections based on surface and well data. The earthquake hypocenter lies below the San Fernando Valley synclinorium which joins the Santa Monica Mountains and Santa Susana Mountains anticlinoria. We have postulated that the anticlinoria are crustal-scale fault-propagation folds underlain by active thrust faults. The Northridge earthquake occurred along the south-dipping Pico fault which builds the Santa Susana Mountains anticlinorium, and cross sectional analysis and mapping of the anticlinorium provides important information on the extent and slip of the Pico fault. The anticlinorium and fault extend eastward from the Simi Valley under the northwestern San Fernando Valley to at least the city of Glendale. The north limb of the anticlinoria is well documented by a continuous zone of steep bedding dips, 2-3 km wide and along the north side of the Santa Susana Mountains and south limb of the Merrick syncline. The Verdugo and San Rafael Mountains are the crystalline rock core of the anticlinorium. The south limb of the anticlinoria outcrops at Laskey Mesa in the western San Fernando Valley, but much of the south limb is concealed beneath the alluvial cover of the San Fernando Valley where it is deformed by less significant faults and folds. Our mapping suggests that only the western half of the Pico fault moved in 1994 and the eastern half may pose a significant seismic hazard to the northern Los Angeles basin.

Related SCEC Publications:

#273. Davis, T. L. and Namson, J. S., Mapping of the 1994 Northridge earthquake fault and the Santa Susana Mountains anticlinorium, southern California: 1995 Annual Mtg., Southern California Earthquake Center (SCEC), p. 52-53.
#274. Davis, T. L. and Namson, J. S., Structural Model of the 1994 Northridge Earthquake: 2'x3' montage, in prep., 1996.

Damage Caused by the 1994 Northridge Earthquake and Site Amplification Effects from Aftershocks

S. Gao, H. Liu, P. M. Davis
Department of Earth and Space Sciences, University of California, Los Angeles, California

L. Knopoff
Department of Physics and Institute of Geophysics and Planetary Physics
University of California, Los Angeles, California, 90095

During the January 17, 1994 M_w=6.7 Northridge earthquake, Sherman Oaks and mid-Santa Monica experienced much greater damage than neighboring regions at similar distances from the epicenter. To understand the cause of the concentrated damage, we installed an array of ninety-eight seismic stations to record aftershocks in the two heavily damaged areas as well as along two profiles across the San Fernando valley and the northwestern part of the Los Angeles basin.

The analysis of peak P- and S-wave amplitudes and Fourier spectral ratios for S- and S-coda-waves from 32 aftershocks indicates that the enhanced damage in Santa Monica is explained in the main by focusing due to a lens structure at a depth of several km beneath the surface, and having a finite lateral extent. The diagnosis was made from the observation of late-arriving S-phases with large amplitudes, localized in the zone of large damage.

We show that the focusing, and hence the large damage in Santa Monica was highly dependent on the location of the Northridge event and that an earthquake of similar size, located as little as one source dimension away, would not be likely to repeat this pattern.

Related SCEC Publication:

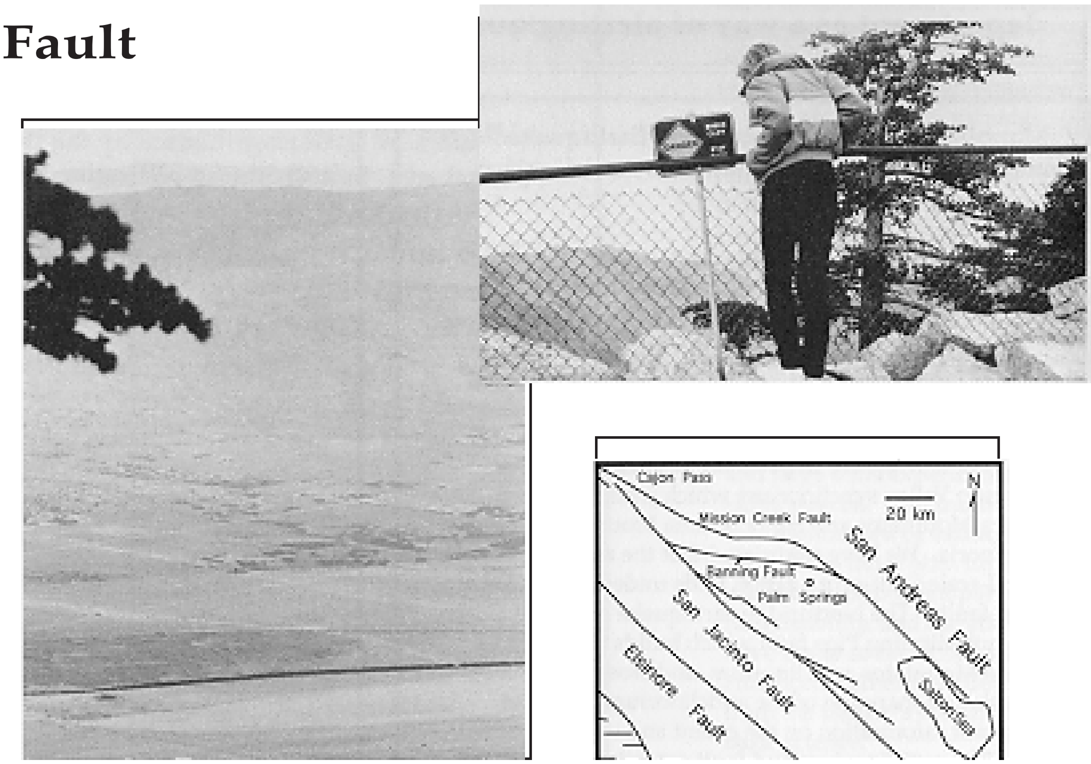
#214. Gao, S.; Liu, H; Davis, P. M.; and Knopoff, L., "Localized Amplification of Seismic Waves and Correlation with Damage due to the Northridge Earthquake", *Bulletin of Seismological Society of America*, accepted, 1995.

See "Selected Studies" on Page 10

Quarter Fault

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

The Southern San Andreas Fault



In this paralyzing view from high atop Mount San Jacinto, the San Andreas Fault is visible as a linear break in the vegetation above the road in the lower half of the photograph.

Inset shows a drawing of the fault location.

*N*ot unlike a nodding callalily bud in shape, the southern segment of the San Andreas fault curves from Cajon Pass to Bombay Beach, on the northeastern shore of the Salton Sea. The fault is one of the most interesting of all of Southern California's many faults for two reasons. First, it exhibits the highest rate of background seismicity of any fault in California; and second, its geometry raised the Los Angeles basin from the ocean floor and thrust the transverse ranges up to their current ragged and imposing heights.

The microseismicity on the fault is primarily concentrated along a sharp, almost east-west trending mini-bend in the San Andreas' "Big Bend" where the main strand of the fault splits into the Banning and Mission Creek segments. The mini-bend is causing extreme compression of the crust, particularly in the San Gorgonio Pass, where basement terrain is being thrust south over sedimentary rock. (Not coincidentally, it's here that one finds the highest mountain range in southern California: the San Gorgonio Mountains.)

At least twenty earthquakes of M_L 5 or greater have occurred on the Southern San Andreas, between Cajon Pass and Indio since 1935, with the most recent large event the 3 July 1986 North Palm Springs earthquake (M_L 5.9). Evidence for slip events of greater than two meters and the recurrence of large earthquakes on an average of every two to three centuries has been found in trenches across the fault near Indio. The best estimates of a slip rate for the southern San Andreas range between 23 and 35 mm/yr, with 30 mm/yr the commonly cited number.

See "SSA Fault" *on Page 9*

SSA Fault *continued from Page 8 ...*

Current estimates for cumulative offset on the southern San Andreas lie between 160 and 240 km since 5 million years BP, when the southern San Andreas first shuddered into existence. The formation of the fault coincided with the onset of seafloor spreading within the Gulf of California region, causing the Baja peninsula to rift from the Mexican mainland.

Since the southern San Andreas lies to the southeast of the central segment, a right step joining the two—the “Big Bend”—formed, and as the right step lies at a high angle to dextral Pacific-North American plate movement, compression intensified throughout the Big Bend region. The Los Angeles basin, which had been lying at the bottom of the sea, stretched, belched out lavas, and collected sediments. The basin "squeezed" together and the transverse ranges began rising to their present heights. This compression continues even today. The Los Angeles basin itself is currently shrinking at about 8 mm/yr.

At 5 MY, the southern San Andreas fault also became the primary boundary between the Pacific and North American plates in southern California. Moving at roughly 30 mm/yr, the southern San Andreas is taking up 60% of the motion between the North American and Pacific plates.

One of the best places to view the southern San Andreas fault is above Palm Springs. Take the tramway at the southwest end of the city up to Mt. San Jacinto and climb up the stairway behind the “Jetsons in Hawaii-motif” restaurant. One of the signs along the lookout point fence shows the location of the fault at the far side of the valley. The view is spectacular. Exhilarating. The sheer drop along the mountain front is almost paralyzing. When the weather is clear, you can see over the treetops as far as the Salton Sea.

And even better, after you’ve breathed deeply the mountain mists, taken in the view and thought about the immensity of crustal plates; after you’ve considered the devastating potential energy locked in the San Andreas and the vastness of geologic time; after you’ve realized just how badly you need to call in sick for the next few weeks in order to stay up there near the clouds, in the grass, eating bananas and chocolate and reading John Muir and Albert Camus; there’s still one final cherry of bliss with which to top off your perfect day, waiting for you at the end of the tramway: A wonderful little donkey ride under the pines at the top of the mountain. ♦

Michael R. Forrest

1996 SCEC-Sponsored Field Trip Scheduled

Save the Date!

Friday, April 19, 1996
The Whittier-Northern Elsinore and Newport-Inglewood Fault Zones
with Dr. Thomas Rockwell

Thomas Rockwell, the leading expert on late Quaternary fault activity in Southern California Faults, will be leading a Whittier-Northern Elsinore and Newport-Inglewood Fault Zones Field Trip on Friday, April 19, 1996. These faults are two of the most hazardous in the Los Angeles region, due to location. In the last century, the Newport-Inglewood fault alone has been the cause for more deaths due to earthquakes in Southern California than any other fault.

The field trip will feature a number of stops along the Whittier-Northern Elsinore fault including a careful look at (landowners’ permitting) offset stream channels and road cut fault exposures. The Whittier fault is currently thought to produce Magnitude 7+ earthquakes every 1,500 or 2,000 years, and is now possibly due for another such quake. There will be at least two stops for the Newport-Inglewood fault, including Signal Hill and either the Huntington or Bolsa mesas, wh will feature a review of sobering but utterly fascinating, recently-unearthed data. In addition to presenting the latest information on the faults, Dr. Rockwell will be discussing the science of paleoseismology and recent trenching in these fault zones. Meals and transportation will be provided for attendees. A splendid, though unsettling time, is guaranteed.

Contact the SCEC Knowledge Transfer Office,
213/740-3459
for information on how to reserve a space!

Selected Studies *continued from Page 7 ...*

WWW Access to Earthquake Related Information from the SCEC Data Center

K. Hafner and R.W. Clayton
Seismological Laboratory, Caltech, Pasadena, CA 91125

As a result of increasing accessibility to the Internet, interest in obtaining information about earthquakes in real time has expanded to a diverse group of users including researchers, emergency response groups, industry, public education, government agencies, the media and the general public. Much of this activity has been focused on accessing earthquake related information via the World Wide Web (WWW). Traditionally, the SCEC-DC has been providing researchers access to the large volumes of archived earthquake data via individual research accounts, as well as providing "near real-time" access to information shortly after an event.

Due to the increased interest in earthquake activity by users outside of the research community, the DC has been developing the WWW interface to provide more general information about the SCEC-DC, earthquakes and activities of the SCEC. Users of the SCEC-DC WWW interface can access seismicity catalogs, "real-time" earthquake locations and maps, and weekly earthquake reports. Work in progress includes a LARSE home page, an "Earthquakes in Southern California" page, and a "Commonly Asked Questions about Earthquakes" page.

SCEC-DC WWW Pages:

"EARTHQUAKES in SOUTHERN CALIFORNIA": This URL is based on the interactive touchscreen display in the lobby of the Seismo Lab at Caltech. It contains information about historic earthquakes in Southern California, including images of earthquake damage, animations of aftershock sequences, rupture models for the Landers and Northridge mainshocks, etc.

http://scec.gps.caltech.edu/eqsocal.html

"Putting Down Roots in Earthquake Country": Based on the handbook recently released to Southern Californians, these pages are a resource to turn to for questions regarding earthquake hazard, the science of earthquakes, or making your home or workplace safer.

http://scec.gps.caltch.edu/eqcountry.html

The LARSE pages are accessible via:

http://scec.gps.caltech.edu/larse.html

Earthquake Size Distribution and Earthquake Insurance

Yan Y. Kagan
Institute of Geophysics and Planetary Physics
University of California, Los Angeles, California 90095-1567

I determine the parameter values for the seismic moment-frequency relation using the Flinn-Engdahl regionalization of global seismicity and the Harvard CMT data. There is no statistically significant variation of the b-value (the analog of the *b*-value) for all seismic regions except for the mid-ocean ridge systems. The maximum moment can be statistically evaluated only for subduction zones treated as a whole, the same as the worldwide value. For other regions, as well as for single subduction zones, M_{max} is determined by comparing the number of events in each zone with the seismic moment rate calculated on the basis of the *NUVEL-1* model of plate motion. No statistically significant variation is found in M_{max} for subduction and continental collision zones, the maximum moment for these regions is the same as the global value.

These results have important implications for seismic risk evaluation and for the development of physical theory for earthquake generation. Since both parameters b and M_{max} do not change in a statistically significant way over continental areas and tectonic plate boundaries, very large earthquakes are possible in practically any urbanized areas. I present evidence that the statistical distribution of losses due to large earthquakes has a power-law (Pareto) tail with an exponent value less than 1.0. If this statement is true, the earthquake average loss is controlled by the largest earthquakes. Since the distribution of earthquake size at the maximum, as well as the distribution of maximum losses are not well known, it implies that insurance premiums can be determined only with significant uncertainty. I simulate the insurance ruin potential for three earthquake loss distributions: exponential, Pareto with exponent 3/2 and with exponent 2/3. The possibility of catastrophic losses due to great earthquakes suggests that the probabilities of the ruin of insurance companies are unacceptably high, unless the risk reserves are equal to or exceed the maximum possible loss.

Related SCEC Publication:

289. Kagan, Y. Y., Earthquake size distribution and earthquake insurance, *Bulletin of the Seismological Society of America*, submitted, 1995.

See "Selected Studies" on Page 25

SCEC Knowledge Transfer Sponsors Insurance Industry Workshop

Over 200 professionals representing the insurance and reinsurance businesses, risk modeling consulting, government and academia attend the November, 1995 meeting.




Clockwise, from above: Participants listen reflectively as State Geologist James Davis, next photo right, describes the working relationship between the Division of Mines and Geology (DMG) and SCEC. Far right and right, Gil Siegel; Jill Andrews and Thomas Henyey.

SCEC Knowledge Transfer, with funding from the National Science Foundation and the Federal Emergency Management Agency, sponsored a two-day workshop November 9-10, 1995, entitled "Addressing Seismic Hazards in Southern California: Establishing Dialogue Among Academia, the Insurance Industry, and Risk Assessment Professionals."

Designed to foster dialogue and open lines of communication among earthquake researchers, the insurance and reinsurance businesses, and risk assessment professionals, the workshop was as much an "end-user" initiative as it was a SCEC initiative. Both groups recognized the value of an exchange such as this at a time when concerns over how to insure property against earthquake hazards has reached monumental proportions.

> ***The insurance industry is looking to the seismic experts to "bring some predictability to the when, to the where and to the how bad of seismic events."***
>
> **...Keynote Speaker Eugene L. Lecomte, President, Insurance Institute for Property Loss Reduction**

Following the keynote address by Eugene Lecomte, President, Insurance Insitute for Property Loss Reduction, and an introduction and overview of SCEC and its Master Model concept by Dr. Thomas Henyey, Center Director, the participants heard a series of short presentations and panel discussions by various members of the SCEC research community. A proceedings volume, which will include abstracts from the presentations, with figures and slides, is scheduled for printing in March, 1996, and will be available through the SCEC administrative offices.

Early in the first day of the workshop, attenders were asked to write comments on what is needed in order to help determine the insurability of earthquake risks. Attenders who were not from the insurance/reinsurance businesses were asked to

See "Insurance" on Page 24

LARSE Highlights: Poster Session at the 1995 Fall Meeting of the American Geophysical Union

The seismic hazard in the Los Angeles region has spawned a joint effort between the U.S. Geological Survey and the Southern California Earthquake Center to initiate a program of seismic imaging to seismogenic and greater depths. The goal of this program, the Los Angeles Region Seismic Experiment (LARSE), is to understand the tectonic framework that gives rise to large earthquakes in this region. LARSE began in 1993 with a passive experiment along a line extending northeastward from Seal Beach across the Los Angeles basin and San Gabriel Mountains. LARSE continued in 1994 with air-gun and explosion experiments along three lines crossing the Los Angeles region and the offshore Continental Borderland.

In the Fall 1995 issue of this newsletter, we featured an article on the LARSE experiment written by USGS scientist Gary Fuis. In this newsletter, we highlight reports from several researchers who are in the process of examining the results of the LARSE experiment. These were poster presentations featured at the 1995 Fall Annual AGU meeting.

Some Observations on the Basement Rocks Along the LARSE Line

LARSE transects several distinct basement terranes whose active tectonic features are superimposed on an older set of complex structural boundaries. The offshore lines are located above the borderland Catalina schist terrane of unknown thickness containing diverse lithologies with no internal stratigraphic control. These lines extended onshore at Seal Beach essentially where Catalina schist appears to be juxtaposed along the Newport-Inglewood fault. The seismic line, following the San Gabriel river north, crosses the great Los Angeles basement depression, unsampled by drilling, to the NW Puente Hills. Between the Whittier Narrows and the Sierra Madre fault exist at least two different E-W fault blocks. Internal basement structures of the San Gabriel Mountains suggest a low angle laminated plate containing many generations of cratonic plutonic rocks resting on the great Vincent gap mylonite zone. Together the plates form an E-W trending antiformal arch which is still deforming under Transverse Ranges compression. The San Andreas fault obliquely transects the N. flank of the antiform and separates the mountain range from the lower relief western Mojave desert. Insights from LARSE into crustal thickness and deep and intermediate crustal structures will be regionally valuable contributions. Not all low angle reflectors are active structures, however.

For more information contact:
L.T. Silver, California Institute of Technology 170-25, Pasadena, CA 91125

Structural Framework of the Los Angeles Basin

Complex crustal structure and basement rock distribution in the Los Angeles region reflects the overlap of three geologic provinces–Peninsular Ranges, Continental Borderland, and Transverse Ranges–and the Neogene history of extension, block rotation, transform faulting, and contraction that shaped those provinces. Geophysical and well data from intensive petroleum exploration in the region extend to depths of 5 km and more, providing significant information on crustal rocks and structure and on Neogene tectonic evolution of the region. This poster offered examples of such data relevant to interpretation of the LARSE Line 1 transect across the Los Angeles basin.

For more information, contact:
Thomas L. Wright, 136 Jordan Avenue, San Anselmo, CA 94960

Tectonics of the Greater Los Angeles Region: Implications for the Lower Crust and Upper Mantle

Pacific-North America transform accommodation is distributed broadly across southern California and its borderland. This deformation is driven by "plate forces" created in other parts of the world. Faulting is dominated by the San Andreas fault, which takes a large left step (Big Bend) through the Transverse Ranges region. Crustal flow and tectonics associated with the Beg Bend are distinctly non-transform in nature: southern California crust acquires an anomalously westerly velocity where it flows around the Big Bend, and thrusting is common where southern California crust "funnels" into the relatively narrow central California Coast Ranges. This activity is attributed to the action of convergence-driving forces created locally by mantle lithosphere converging and sinking beneath the Transverse Ranges. Crustal convergence driven by these forces would occur at greater rates across the width of the Big Bend were it not for the divergence-driving forces generated

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Please note: not all posters with abstracts exhibited at the Fall, 1995 AGU meeting are mentioned here. Some editing of those listed here has been done due to space limitations. A complete set of the abstracts can be found on pages F347 - F349, in the 1995 Fall meeting abstract volume of the American Geophysical Union.

LARSE, *continued from Page 12 ...*

by the Transverse Ranges topography. Instead, crust such as the San Gabriel block avoids convergence by “escaping” to the west, accommodated in part by left-lateral faulting along the southern margin of the Transverse Ranges; large amounts of thrusting are thereby transferred to the western Transverse Ranges, where thrusting requires less work because topography is lower.

For more information, contact:
Eugene Humphreys, University of Oregon, Eugene, OR 97403

Overview of Shipboard Work During the LARSE

Shipboard operations provided a critical component of the LARSE. The goals of the marine work were to better define the subsurface geometry of offshore faults and to undershoot crustal structures near the coast, including the Los Angeles basin. During the October 1994 experiment, we used an airgun array towed by the *R/V Maurice Ewing*, to obtain 660 km of deep-crustal seismic reflection data in the Inner California borderland. The airgun array was also used as a seismic source for a wide-angle seismic investigation. The three main LARSE onshore-offshore lines were each 200-250 km long, with the offshore portions being between 90 and 150 km long. Nearly 24000 airgun signals generated by the *Ewing* were recorded by an array of 170 recorders deployed at 2-kkm intervals along all three of the onshore lines and 9 ocean bottom seismometers deployed along two of the lines. The *Ewing's* digital streamer was also used to record seismic-reflection data. To enhance the fold of the wide-angle data, mitigating against cultural and wind noise in the Los Angels basin, the entire ship track was repeated at least once during late-night hours, resulting in about 660 km of unique trackline coverage in the Inner Borderland. Short reflection lines were also acquired over the Palos Verdes fault to the southeast of the primary LARSE survey area. A variety of other geophysical data were also continuously recorded. This poster presented initial results from the multichannel seismic reflection and ocean bottom seismometers wide-angle profiles.

For more information, contact:
T. M. Brocher, K. D. Klitgord, R. Bohannon, and R. Sliter, USGS, 345 Middlefield Road, MS 977, Menlo Park, CA 94025;
R. W. Clayton, California Institute of Technology, Pasadena, CA 91125; and
U.S. ten Brink, USGS, Woods Hole, MA 02543.

Refraction/Wide-Angle Reflection Imaging of the Los Angeles Region Using Onshore-Offshore Seismic Transects

The tectonic framework of the Los Angeles region includes the Transverse Ranges, Los Angeles-San Fernando-San Gabriel basins, and continental borderlands. A major component of LARSE was to image, on a crustal scale, these tectonic elements using refraction-wide angle reflection profiling which involved land-based portable recorders to receive airgun signals generated offshore by the *R/V Ewing*. This approach yields velocity and structural information for the full crust. The method was successful even considering the dense population of Los Angeles and the nearness of major tectonic elements to the coastline.

The *Ewing* collected 16 ship track lines while profiling in-line to the three land arrays. Due to weather and cultural noise in Los Angeles, multiple passes were made in-line with the three arrays. All instruments recorded the airgun continuously. Data quality ranges from poor to excellent. The best data on all three profiles were collected near the coastline, in the Transverse Ranges, and in the Mojave Desert. Data quality rose during the night shooting and when the weather was calm. The quality was poor in the urban parts of Los Angeles, particularly in the daytime. These data should provide crustal-scale velocity and geometrical structure information through the use of both forward and inverse modeling.

For more information, contact:
David Okaya, Joyjeet Bhowmik, Michelle Robertson, Thomas Henyey, Dept of Earth Sciences, University of Southern California, Los Angeles, CA 90089;
Gary Fuis, Janice Murphy, USGS, Menlo Park, CA 94025;
Robert Clayton, Katrin Hafner, Mark Benthien, Julie Norris, California Institute of Technology, Pasadena, CA 91125;
Paul Davis Dept. of Earth and Space Sciences, University of California, Los Angeles, CA 90024;
Kate Miller, Dept. of Geological Sciences, University of Texas, El Paso, TX 79968.

Analysis of Offshore-Onshore Data Collected During the 1994 LARSE Survey

The portion of data analyzed in the study includes over 1300 sources. Stations in the San Gabriel Mountains, Channel Islands, and some portions of the Mojave Desert show excellent recordings of various crustal phases. Stations in the Los Angeles Basin and some locales in the Mojave Desert show moderate to poor data. The geometry of the experiment is such that highfold midpoints exist in the borderland and Los Angeles Basin area. This allows the gap between the marine MCS and land explosion components of the LARSE 94 survey to be filled in.

Lateral variation in the travel times and waveforms show that crustal structure in the area is quite complicated. An initial reconstruction shows a coherent sub-horizontal reflector in the mid crust. Examples of the raw data and results from the analysis of the seismic images of the crust beneath the Los Angeles Basin and offshore borderland region were presented in this poster.

For more information, contact:
J.J. Norris and R. W. Clayton, California Institute of Technology, Pasadena, CA 91125.

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Feature: visit with a SCEC scientist

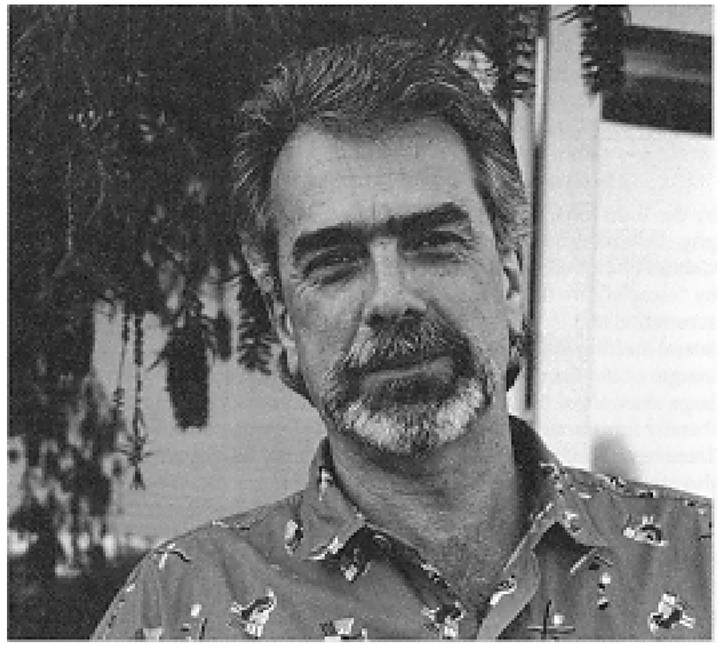
A Visit with Bruce P. Luyendyk

Profile

Bruce Luyendyk is probably best known for discovering that the Western Transverse Ranges and some of the Channel Islands have rotated (in some cases over 90 degrees), and for his crustal block rotation model for southern California. "Bruce pioneered the whole paleomagnetic investigation of the tectonic rotations in southern California's Transverse Ranges. He had the paradigm with which to study the rotations," says Mobil Oil geologist and former Luyendyk graduate student Scott Hornafius.

Luyendyk received his B.S. in Geology (Geophysics) from San Diego State College (1965) and his Ph.D. in Oceanography (Marine Geophysics) from Scripps Institute of Oceanography (1969). He teaches at the University of California at Santa Barbara, where he is Professor and Director of the UC Institute for Crustal Studies. Luyendyk has been chief scientist on oceanographic cruises in such diverse areas as the New Hebrides Island Arc, the Bahamas, and the Indian Ocean. He has received numerous honors and distinctions including the Newcomb Cleveland Prize of AAAS, and an Antarctic Service Medal from the U.S. National Science Foundation and the Department of the Navy.

Luyendyk is engaged to be married to "Susan," and has a son, Loren, who is studying ethnobotany under the auspices of the UCSB Education Abroad program at Auckland University in New Zealand.



The Interview

by Michael Forrest, Associate Editor

What is your current involvement with SCEC?

A couple of things: Ralph Archuleta and I did a SCEC workshop last January on detachment faults and thrust ramps in the Western Transverse Ranges. I have a long-term interest in the Transverse Ranges, and the issues of detachment faults and blind thrusts are now critical. The workshop provided the first forum where data pertinent to the question of thick- or thin-skinned deformation in the Western Transverse Ranges could be reviewed.

Another project I've been doing with Scott Hornafius from Mobil Oil is mapping the North Channel fault using high resolution seismic surveys. The North Channel fault is a fault propagation fold underneath the Santa Barbara coast that dips north 30 degrees or so. It appears to have been the source of the 1978 Santa Barbara earthquake. It runs from Ventura, where it is called the Pitas Point fault, to Point Conception. It is

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Luyendyk ***continued from Page 14 ...***

capable of M7+ if it ruptures along its entire length, although our mapping shows it is segmented in 15 km lengths in several places offshore Santa Barbara. There is a tsunami threat, and a quake that occurred in 1812 supposedly generated one that ran up Refugio Valley. We are looking into the slip rate and have determined 3.2 mm/yr since 1.8 m.a.

As you know, the main SCEC activity is directed by Ralph Archuleta in the Institute (ICS), and I'm a player on the team. Ralph directs and shepherds. That's how it works.

One of the most interesting ideas to come out your ICS tectonics group is the idea of "subducted slab capture," to provide a mechanism for the rotations we see here in southern California, and the opening of the Los Angeles Basin.

Yes, it's a provocative and enticing idea. U. S. Geological Survey researchers are working on the concept in parallel with us. I think this, of course, touches on our rotation model concept. In 1980 we recognized that these crustal blocks are rotating–and gaps and basins had to be opening at the boundaries of the blocks where they were in contact with the blocks that were not rotating. Then we recognized there was a space problem, that a considerable amount of dilation that must be occurring for basins to open up.

In 1991 I wrote a paper which dealt with that dilation issue, and followed up on concepts that were elaborated on by Dan McKenzie (M.I.T.) and James Jackson (M.I.T.). They had a theoretical treatment of crustal rotations which maintained that dilation was necessary to get large rotations (there had to be dilation to take care of the space problem), so I think that what was missing was a believable, coherent mechanism which could make this all happen. And the slab capture concept, even though it seems slightly outrageous, definitely takes care of that issue. You have a mechanism for stretching the continental margin and opening up a lot of space.

You are the one who basically discovered that the Transverse Ranges have rotated. That's an amazing thing to discover. How did it happen?

I love to talk about how that started, because it's a perfect example of looking for one thing and finding something different. When I first came to Santa Barbara, I was trained as an oceanographer-marine geophysicist. I worked at Woods Hole as a marine geophysicist, decided to get into academia, and I took this job. When I came to California, I asked myself, what are some of the big puzzles? What intrigued me?

One answer was the bend in the San Andreas fault, and the Transverse Ranges, which didn't line up with the structures. So I thought we could use paleomagnetism to see if there was twisting involved with this pattern. I wrote a proposal using the principal of least astonishment: "Let's say the bend in the Transverse Ranges all occurred due to counterclockwise bending of thirty degrees." I recruited Marc Kamerling as a graduate student, to work on this with me. When we started, we found out that the paleomagnetic vectors were apparently deflected clockwise a huge amount. And we went through quite a few gyrations before we believed this. We first thought our sampling was

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John Crowell on Luyendyk and the founding of ICS:

"Bruce has managed to get the ear of the [University] administration. He runs a tight ship–watches things closely. He has a wide range of interests, which is good because ICS is truly multi-disciplinary...we saw a need for this kind of institute, both for geosciences and the University. With the approval of the Chancellor, we made it work..."

Luyendyk *continued from Page 15...*

in error, or our instruments were in error, and so we did a number of blind tests, and sent out samples to other labs.

It must have been an amazing moment when you realized that some of these blocks had rotated 90 degrees.

Yes it was. I remember taking the results of Kamerling's work up to the annual meeting of the American Geophysical Union with the intention of showing it to a few people and getting some feedback. I sat down on a sofa with paleomagnetism pioneer Allen Cox during a break, and I remember pulling this stuff out and asking, "What do you think about this?" Coincidentally, Merl Beck (Western Washington University) had written a 1976 paper on rotations along the western north American Cordillera as a concept, and so Cox said, "This fits in perfectly with this whole scheme—it just happens to be two or three times more than we expected. You've got something, you should go with it." I was a young researcher at the time, so I was ready to charge with it.

There must have been a moment when you were outside and looked at the western Santa Ynez mountains and just thought to yourself, "My God, that's rotated 90 degrees."

I think that happened to me in 1977. We took a trip over to Ana Capa Island, and I remember that moment, looking back at the whole backdrop of the Santa Ynez Islands. It was a clear September day, and I could see for fifty miles, and I remember thinking that this is astonishing. Here we are with all of this underfoot. This ground was pounded by a lot of expert geologists, who didn't recognize that, or didn't deal with it. (To be fair, there were a couple geologists who did suspect that this had happened: [David L.] Jones [U.C. Berkeley] and his colleagues, who wrote about the California borderland in a "soft publication" in 1976. They hypothesized that it was twisted out of alignment clockwise because of plate motions.

Another key moment was in 1979. Crowell was visited by Raphael Freund, from Israel. Of course, I didn't know this at the time, but he was an expert on crustal block tectonics, and he said, "You know what this is? Block rotations. These are the northwest dextral faults and here are the east-west trending sinistral faults. This is going to be a block rotation model." Afterwards I sat down and thought about how this could work, what faults could come into play, and the amounts, the timing, and put it all together.

You've been to the bottom of the ocean. That must have been interesting...

In the Alvin, we went down 2600 meters. The Alvin is free swimming. You're looking out a porthole. The only light you have is artificial light. It takes about an hour and a half to get down. It's very cramped. You've got three people inside this six-foot diameter sphere, plus instruments. There's very little room. When anybody moves, someone else has to move. And then when the sonar tells you you're a 100 meters or so off the bottom, you turn the lights on and look out the portholes which are slanted down. Your field of view is probably 30 meters. What you do see is alien.

I remember that experience—the seafloor first coming into sight and the overwhelming rush of knowing that you're visiting and seeing a place that probably is the most alien spot on earth. It's overpowering. The colors are greenish-gray with outcropping basalts that are fresh and jet black. And then on one of the dives we visited a hot water vent community. We saw a completely different array of colors, of

See "Luyendyk" on Page 17

Ralph Archuleta on Luyendyk:

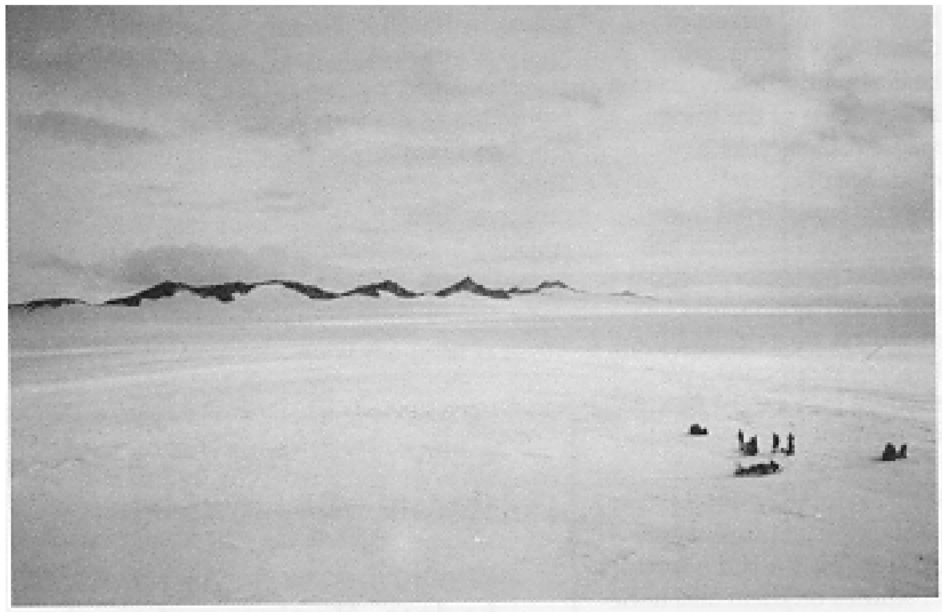
"...Once Bruce learned to use e-mail, timber harvests showed noticeable decrease, but our e-mail folder fills up. As part of his administrative style, Bruce keeps everyone informed about everything. He doesn't bury something hoping it will suddenly take care of itself—he deals with questions quickly, or sends it on to someone else to deal with."

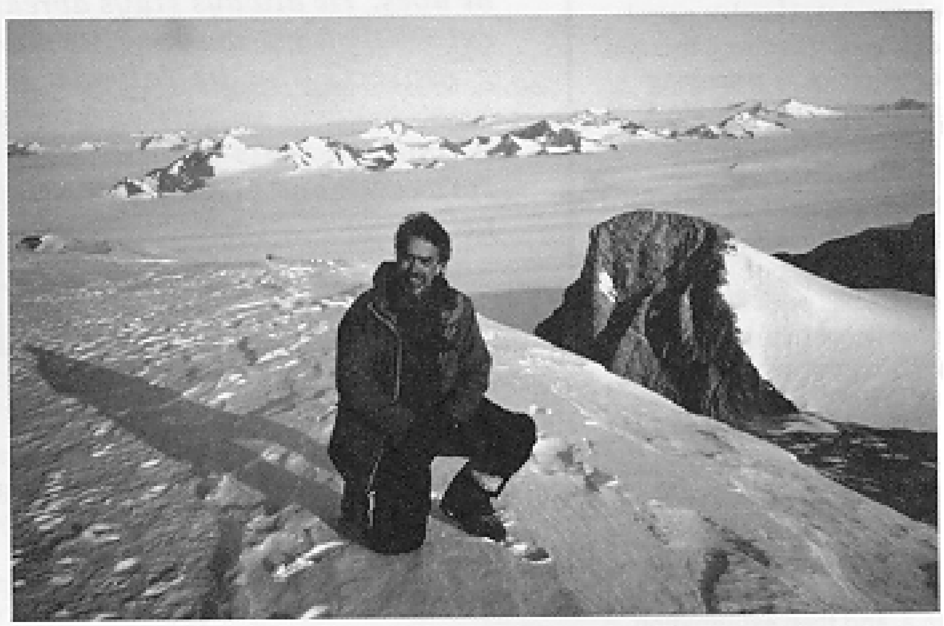
Luyendyk *continued from Page 16...*

whites and deep reds and yellows and oranges and all the animal life. It's one thing to crawl on the sea floor and the volcanic rocks and sediment, but when you come across one of these living gardens, that's a shocker. The vent communities are kind of rust colored, they're supported by a chemo-synthetic system which is built on bacteria synthesizing hydrogen sulfide. The creatures we saw were tube-worms. They're about six feet long and they grow off the bottom like white stalks of corn, with their red heads or gills sticking out. And the seafloor is crowded with clams which might be on the order of twenty centimeters long, and are white in color. There are white crabs crawling around and a few rat-tail fishes. There's a dense concentration of life around the shimmering hot water coming out of the seafloor.

More recently you've been doing work in Antarctica?

I'm currently looking at cooling history of ranges in the western Antarctic. I've made three expeditions to western Marie Byrd Land which is on the Pacific coast of Antarctica, due south of New Zealand. I'm about to leave on a fourth in January 1996. The first three expeditions we made were on land, on ice. But this next trip is a marine geology expedition.





Top: Chester Mountains, Northern Ford Ranges, Marie Byrd Land.

Bottom: Bruce Luyendyk, on the "Billboard" Sarnoff Mountains, Ford Ranges, Marie Byrd Land, January, 1993.

See "Luyendyk" *on Page 18*

Luyendyk *continued from Page 17...*

We're searching for the remnants and effects of Gondwana rifting, which is basically middle Cretaceous in age. One of the things we've come across is evidence of crustal stretching and uplift from mid-crustal depths, which has exposed metamorphic rocks in a rather spectacular mountain range called the Fosdick Mountains. We thought they might be a metamorphic core complex.

It turns out they don't have a lot of the features of core complexes. We did a series of studies on them and none of our metamorphic petrology, geochronology, thermal chronology, or paleomagnetism studies indicate they are core complexes. We do find the range was exhumed or uplifted between about 100 and 94 million b.p., from about 15 km in depth, has peak metamorphic temperatures of about 700 degrees, which is extremely high for that depth. So the whole region was heated, stretched, block faulted, and tilted.

It appears the faulting started at about 105 million m.a. and then exhumation and uplift got underway at about 100 million m.a., and continued to about 94 million. All of this happened when Gondwana was breaking up. But interestingly, the actual sea floor between the microcontinents which split off east Gondwana is younger. It's 85 million m.a. So there's a whole history of stretching and faulting before it actually ripped apart and formed sea floor. That's 20 million years of prolonged stretching and cracking before it actually ripped apart.

Scott Hornafius, Geologist, Mobil Oil, former Ph.D. student with Luyendyk:

"Bruce has an eye for what's important. He's good at what he does. He always stays abreast of where science is. He's extremely hard-working, he makes sure that when he does a project, that he follows it through to completion: Documenting it, getting students to finish their theses, helping students publish work or presented in meetings. He's very good at administrating, and treats everyone with fairness."

What's it like working in Antarctica?

Going down to the bottom of the ocean is a profound experience, but it's nothing like working in Antarctica. Antarctica is an absolute wilderness. The continent is as big as the United States and Mexico. The maximum population is 2,000 people—and that's in the summertime—with virtually all of those people located on the coast. It's uninhabited wilderness, given to extremes of unpredictable weather and unpredictable situations. When we went to Western Marie Byrd Land, we deployed out of McMurdo Station, which is the main base. We put together field gear for six weeks in McMurdo—food, tents, fuel, sleds, and snowmobiles—loaded it all onto a ski planes, and flew to the field area, 800 miles out.

We landed on a snow field, and while the engine was still running, they dumped out our gear, and flew off right after we deplaned. So there we were. I've done a lot of cruising all over the world on oceanographic ships, I've been in the middle of the Pacific Ocean where there's absolutely nothing, but that's the first time I actually thought, "Here I am on my own in the middle of absolute wilderness."

The plane gone, we were looking at complete whiteness with outcrops of snowy mountain ranges. Away from the coast, there's no life. What's also interesting is that there's nothing familiar to use for scale. You can't tell how far away or how big outcrops are, because there aren't any trees, there aren't any telephone poles, there aren't any roads, cars, houses, or people. Invariably everything always ends up being farther away and bigger than you think it is.

It's a very stormy place. We sat through any number of blizzards. The ambient temperature is about minus five degrees centigrade. That's not so bad—the problem of course, is wind. If there's any wind moving,

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Luyendyk *continued from Page 18...*

then minus five degrees centigrade is an extreme situation. During the blizzards we could not move. On my last expedition we were two to a tent, sitting there, ten days, waiting for a blizzard to die off and move on. But we adapted. We read a lot of books, and played cards, and cooked.

What are you planning next?

What I hope to do in the near future is start a project using geodetic Global Positioning in the Santa Barbara Channel region. I'm going to put three continuous GPS receivers across the channel to monitor deformation in real time, as part of the Southern California Integrated Geodetic Network (SCIGN).

How did you get interested in the Geosciences?

When I was in high school, I'd never heard of earth science or geology. I thought I was going to be a chemistry student. While on a tour of San Diego State college, for "student's day," I wandered down into the basement to the Geology Department and they had all these great displays of geologists traveling and camping all over the world. I said, "Hey, that definitely sounds more interesting than working in a chemistry lab." ♦

Related SCEC Publications:

#263. Sorlien, C. C., Gratier, J. P., Luyendyk, B. P., Hornafius, J. S., and Hopps, T. E., Finite displacement field across the Oak Ridge Fault: Restoration of a folded and faulted layer near onshore and offshore Ventura Basin, California: *Geology*, submitted, 1995.

#264. Sorlien, C. C., Luyendyk, B. P., and Hornafius, J. S., Fault block circuit around the Oak Ridge fault: Unfolding of Santa Barbara Channel, California, Supplement to *EOS*, Transactions American Geophysical Union, 75 (44), p. 622.

LARSE *continued from Page 13 ...*

Crustal Structure of the Inner California Borderland - Preliminary Results

Preliminary analysis and modeling of the data indicates that the crustal structure between shore and San Clement Ridge may differ from that under and southwest of San Clement Ridge. Shots fired northward across the Catalina Ridge on Lines 1 and 2 are highly attenuated, whereas those fired southward across the ridge are not. Shots fired across the San Clement Ridge in both directions are, on the other hand, unaffected by the ridge. Schist, granite, and mafic and ultramafic rocks are uplifted and exposed on Catalina Island, whereas San Clemente Island has only Miocene sedimentary outcrops. If the attenuation across the Catalina Ridge is due to a (dipping?) propagation barrier, then the barrier probably extends at least 8 km deep and may be composed of rocks similar to those exhumed on Catalina Island.

For more information, contact:
U.S. ten Brink and R. Drury, USGS, Woods Hole, MA 02543;
D. Okaya, Dept of Earth Sciences, University of Southern California, Los Angeles, CA 90089;
R. Bohannon, T. Brocher, and G. Fuis, USGS, USGS, Menlo Park, CA 94025.

An Image of the Upper 5 km from Inversion of First Arrivals from the 1994 LARSE Experiment: Line 1 from Seal Beach to El Mirage Lake

This poster presented results from inversion of first arrivals from Line 1 of the LARSE. The source-receiver geometry is highly suitable for inversion methods. The outer flanks, LA Basin, and Mojave Desert, include a sparse number of sources and receivers at an interval of 500 m. This geometry and inclusion of secondary arrivals and S-wave data will allow imaging of geologic structure and fault geometry. A preliminary inversion including only P-wave arrivals from sources and receivers, yields a highly detailed velocity image of the upper 5 km.

The inversion images the LA Basin as a region of low velocities ranging from 2.0 km/s (at sea level) to 4.0 km/s (at 2.5 km depth) bounded to the northeast by two "steps." At each step velocity increases laterally by roughly 1.5 km/s within one horizontal grid interval (1.5 km). A region of high velocity dips to the SW beneath the San Gabriel mountains. The San Gabriel Fault is not as well delineated, but may be imaged as a broad low-velocity zone. A smaller basin with lower velocities ranging from 2km/s at the surface to 5.5 km/s (at 1.5 km depth) is bounded to the SW by the San Andreas Fault at 80 km. A sharp "step" positioned at 86 km within the basin may correlate with a mapped Quaternary fault roughly 6 km NE of the San Andreas Fault.

For more information, contact:
W.J. Lutter, C. Thurber, U. Wisconsin-Madison, Madison, WI 53706;
G.S. Fuis, USGS, 345 Middlefield Road, Menlo Park, CA 94025.

Crustal Structure Beneath the San Gabriel Mountains, CA (LARSE)

As part of the LARSE survey, a dense reflection/refraction profile was conducted along a line extending northeastward from Seal Beach across the Los Angeles basin and over the Transverse Ranges (San Gabriel Mountains) in Southern California. the survey consisted of 622 receivers (1- and 3-component), spaced at 100 m intervals under the mountains. This array recorded 64 explosions spaced at approximately 1000 m intervals along the line, producing a database consisting of ~37,500 seismic traces.

This portion of LARSE had three main objectives: 1) to obtain an image of the mid-crustal detachment zones beneath the Transverse Ranges; 2) to image the steeply dipping thrust fault systems along the front ranges of the San Gabriel Mountains; and 3) to image older low-angle thrust faults, e.g. the Vincent Thrust. Preliminary results obtained from a brute stack suggest that a mid-crustal detachment zone exists at 6.5 to 7 seconds or ~20 km depth beneath the San Gabriel Mountains. A second subhorizontal reflector is seen at 11-12 seconds (~36 km depth). Preliminary results from shot gather analyses show evidence for dipping faults on the south side of the San Gabriel Mountains. At this time, no evidence for high angle faults on the north side of the range or of the Vincent Thrust has been seen.

These and further results from the analyses of images of the crustal structure beneath the San Gabriel mountains were presented.

For more information, contact:
K. Hafner and R. W. Clayton, California Institute of Technology, Pasadena, CA 91125.

Refined Three-Dimensional Velocity Model for the Central Transverse Ranges and the Los Angeles Basin

We use earthquake arrival time data to invert for the Vp and the Vp/Vs structure beneath the central Transverse Ranges and the Los Angeles basin. Explosion data, recorded by the Southern California Seismic Network, from quarry blasts and the LARSE experiment are also included in the inversion. To determine the best possible model we perform graded inversions with 40, 20, 10, and 5 km grids. Layers of grid nodes are placed at depths of 1, 4, 6, 8, 12, 16, and 20 km. The sum of the diagonal of the resolution matrix increases with decreasing grid spacing down to the 10 km grid, but decreases slightly for the 5 km grid indicating that the 5 km grid model is not significantly better than the 10 km grid model. The data variance decreases 60% as a result of the inversions. Ample data from the 1994 Northridge and other earthquake sequences, the rich background seismicity, and the dense station distribution along with controlled sources make the model well resolved, except along the edges and at depths greater than 20 km.

The study area includes the Los Angeles basin, the central Transverse Ranges and the eastern Ventura basin. At shallow depth the graded inversion Vp velocity model images the shape of the Los Angeles and eastern Ventura basins.

See "LARSE" on Page 21

LARSE *continued from Page 20 ...*

The Los Angeles basin extends to a depth of 8 km and is bracketed by the Newport-Inglewood fault on the west and by the Whittier fault on the east. The east Ventura basin elongated in an east-west direction narrows with depth to 12 km. The north edge of the Peninsular Ranges, the Santa Monica, and the San Gabriel mountains, form high velocity ridges. In detail the Santa Monica mountains form two high velocity ridges, in the depth range from 0 to 10 km, separated by a zone of intermediate velocities, located north and west of the northern terminus of the Newport-Inglewood fault. Similarly, the velocity structure of the San Gabriel mountains exhibits complex geometrical relationships with the nearby lower velocity basins. At seismogenic depths of 16 km the hypocenters of moderate-sized and large earthquakes are located within or adjacent to high velocity bodies. The Vp/Vs model shows high Vp/Vs ratios beneath the east Ventura and the Los Angeles basins, extending to depths of 16 and 12 km, respectively. The high Vp/Vs beneath the basin sediments may indicate the presence of pore fluids or mafic intrusions. Such mafic bodies may be remnants of ophiolitic assemblages or mid Miocene volcanics.

For more information, contact:
E. Hauksson, California Institute of Technology, Pasadena, CA 91125.

Structural Features Under Southern California From Teleseisms Recorded During the LARSE Passive Phase

The LARSE consisted of two phases: passive (fall, 1993) and active (fall, 1994). During the passive phase, approximately 88 stations were deployed in a 175-km-long, linear array across the Los Angeles Basin, San Gabriel Mountains, and Mojave Desert northeast of Los Angeles by scientists from the USGS, UCLA, Caltech, and USC. During the four weeks of continuous recording, over 160 teleseismic and over 400 local events were recorded at each site. The goal of this experiment was to collect waveform data from local and distant earthquakes to obtain three-dimensional images of lower crust and upper mantle structural features in Southern California, particularly under the San Gabriel Mountains and San Andreas fault.

P-wave travel times were determined from station records of 17 teleseisms and corrected for topography and one-dimensional Earth model. Within each back-azimuth range, the resulting travel-time residual curves display consistent patterns with relatively low residuals at the southern San Gabriel Mountain foothills and relatively large residuals across most of the San Gabriel Mountains, including the San Andreas fault. The most drastic differences in residuals, occurring for raypaths from the northwest (Kamchatka and Unimak Island), were about one second. The travel-time residual curves, although displaying small variations for different raypath arrival directions, show almost no lateral spatial shift of maximum or minimum residual along the array, indicating that the source of the residual is shallow. The patterns of residuals suggest that a sharp change in shallow (<30 km) velocities is required between the L.A. Basin and the San Gabriel Mountains over a horizontal distance of less than 10 km. This could be accomplished by a model of Southern California crust which consists of oceanic crust under the L.A. Basin to the southwest of the array next to continental crust under the San Gabriel Mountains with a shallow, low-velocity anomaly located near but not directly underneath the stations in the mountains.

For more information, contact:
M.D. Kohler, P.M. Davis, H. Liu, S. Gao, and G. Pei, Dept. of Earth and Space Sciences, UCLA, 90095-1567;
M. Benthien, California Institute of Technology, Pasadena, CA 91125.

Seismic Reflection Profiling across the Northern California Continental Borderland

In recent years a number of crustal-scale seismic reflection surveys have become available in the northern California Continental Borderland. These include the 1990 USGS survey, the 1994 LARSE survey, as well as oil industry data that cross the Patton Escarpment, Santa Rose-Cortes ridge, and the Santa Cruz and Santa Monica basins. These data provide a renewed opportunity not only to test models of Borderland evolution, but also to assess earthquake hazards in the offshore region. the data allow for a detailed investigation of the proposal that the inner borderland was subjected to large-magnitude crustal extension in early Miocene time. In addition, the data place constraints on the extent to which contemporary thrust tectonics, as exemplified by the 1994 Northridge earthquake, have propagated southward.

Preliminary results from a joint interpretation of seismic reflection data from the 1990 USGS survey, the 1994 LARSE and industry data suggest that the Miocene deformation of the inner borderland can be interpreted to show extensional features such as detachment faults and core complexes. Data in the Santa Monica basin show little evidence for Holocene reverse faulting. However, in the Santa Cruz basin, movement on at least one reverse fault, has uplifted the seafloor and folded Pliocene to Recent sediments.

For more information, contact:
F. Hua, F. E. Kilbride, and K. C. Miller, Dept of Geological Sciences, University of Texas at El Paso, El Paso, TX 79968-0555.

Note: The abstracts featured here are fairly technical in nature, and will not necessarily appeal to all of our readers. However, we have had significant numbers of our subscribers request abstracted material from selected research projects–specifically LARSE–and decided to accommodate them.

–Editor

♦

USGS Fact Sheets on Reducing Earthquake Losses Available through Fax and WWW

The U.S. Geological Survey (USGS) announces the availability of the fact sheet series, Reducing Earthquake Losses Throughout the United States.

The series documents how activities supported by the USGS component of the National Earthquake Hazard Reduction Program contribute to the reduction of earthquake losses. The color-illustrated fact sheets highlight a wide range of loss mitigation actions that in various ways have been stimulated or facilitated by information derived and disseminated by the USGS and by collaborating government agencies, universities, consulting companies, and corporations.

The series currently includes the following titles:

The Los Angeles Dam Story (7180)
Speeding Earthquake Disaster Relief (7181)
Averting Surprises in the Pacific Northwest (7182)
Utah Braces for the Future (7184)
Building Safer Structures (7187)
The Mississippi Valley—"Whole Lotta Shakin' Goin' On" (7183)
Pay a Little Now, or a Lot Later (7185)
Saving Lives Through Better Design Standards (7188)
Seismic Maps Foster Landmark Legislation
Southern Californians Cope With Earthquakes

Copies of the sheets are available by mail from:

Earthquake Information Hotline
U.S. Geological Survey, MS 977
345 Middlefield Road
Menlo Park, CA 94025

Fax copies without illustrations are accessible from Earthfax (the USGS fax-on-demand system) by dialing **(703) 648-4888**, pressing button 4, and requesting individual sheets by their fax document numbers (see above). The Fax Server can also be reached at **1-800-usa-maps** (1-800-872-6277).

The sheets are also accessible via Internet from the homepage address:
http://quake.wr.usgs.gov/QUAKES/FactSheets

Will Prescott

Earthquake Map Now Available from the U.S. Geological Survey

"Earthquakes in California and Nevada" depicts the epicenters of 300,000 earthquakes, including 49 of magnitude 6.5 or larger that have occurred in the two-state area since 1836.

The map offers a ready reference for areas that have had few if any earthquakes during the past 160 years. California's great central valley, for instance, has only a few dots depicting earthquake epicenters.

The map, priced at $12 for a paper copy or $22 for a laminated copy, including shipping costs, is available by mail only from:

Earthquake Maps
U.S. Geological Survey
Box 25046, Federal Center, MS 967
Denver, CO 80225

Orders must include the name and number of the map "Earthquakes in California and Nevada; Open-File Report 94-647", and a check or money order, payable to DOI/USGS.

SCEC Global Science Classroom Activities

SCEC/Palos Verdes School District Partnership Forged

The SCEC Global Science Classroom Program has recently established a comprehensive five-year educational partnership with the Palos Verdes Peninsular School District in suburban Los Angeles. The district ranks among the top five academically in California and has recently been designated as a GLOBE project site through a global science program sponsored by a host of federal agencies that monitor the condition of Earth's ever-changing environment.

The five-year plan is aimed at systemic restructuring of the science program in the district with emphasis on the following:

* Teacher training with respect to the earth sciences, focusing mainly on geosciences and earthquakes;

* Utilization of the Palos Verdes peninsula environment as a natural laboratory for investigation;

* Enrichment of the science curriculum at the elementary and secondary levels, with strong emphasis on (earth) scientific investigation processes — i.e. data gathering, manipulation, analysis, interpretation and communication — through traditional science and social science courses and a recently developed "research" course which is presently grounded in library "research" only. The enhanced class, with SCEC assistance will allow students to interface with SCEC scientists on projects;

* Mobilization of a large number of students who will be conducting various scientific studies over the five year time horizon of the partnership;

* Equipping the high school and middle schools with the technological tools — GPS instruments, the CUBE seismic recording system, a gravimeter and a magnetometer — and training staff and students to successfully use and maintain them;

* Linking the science education work in the schools with the community — from local to global — through telecommunications networks; and

* Providing incentives for high achievement in science among high school students.

These kinds of comprehensive systemic partnerships are believed by the educational community to be of great value in solving the country's science education crisis. The National Science Foundation is presently funding a number of initiatives in school districts –both urban and rural–across the nation in an effort to increase the effectiveness of science education for large numbers of teachers and students. ♦

Curt Abdouch

Employment Opportunity with SCEC

We are currently accepting applications for the position opening of SCEC Program Specialist, who will aid the directors for Knowledge Transfer and Education on a full-time basis. Some tasks include:

• Assistance with organization and implementation of planned workshops. Type of assistance will include facilities procurement; logistics such as printing, distribution, and collection of programs announcements and registration forms and fees; compiling workshop, field trip and conference materials; handling public inquiries regarding all SCEC activities.
• Assistance with promotion and distribution of "Putting Down Roots in Earthquake Country," an earthquake education and preparedness handbook.
• Assistance with development and production of SCEC quarterly newsletters and other promotional materials.
• Assistance with organization and implementation of field trips.

Skills and abilities required: Ability and desire to support and promote the SCEC mission and its outreach programs. Demonstrated success in the areas of events coordination, with particular emphasis on conference/workshop organization. Ability and willingness to learn "basic geo-jargon;" to learn Macintosh applications including Word for Macintosh, Claris Filemaker Pro, Excel, Aldus Pagemaker. Ability to learn to listen to SCEC end-users' requests and direct end-users to sources which can provide solutions or answers. Ability to follow directions. Must possess good verbal skills; ability or background in sales and marketing a plus.

Please contact by February 26, 1996:
USC Employment Office
FIG 100, MC 1260
Los Angeles, CA 90089-1260
phone 213/740-7252
Job Requisition #31810

USC is an Equal Opportunity Employer.

Insurance *continued from Page 11 ...*

describe their needs in dealing with earthquake hazards from the perspective of their organizational role. Late in the second day of the conference, and after small group discussions, attenders were asked for advice to SCEC and the earth science community on supporting earthquake risk insurance decision making. Responses were made on small paper slips, one idea per slip. Following the workshop, the slips were analyzed by USC Social Scientist Gil Siegel, who wrote a detailed report to be included in the proceedings.

Based on what was learned at the workshop and elsewhere, attenders were asked to comment on what they needed to do, to learn, to obtain, etc., or what products are needed in order to help them determine the insurability of earthquake risks. Specific suggestions were made in the areas of data availability; data on earthquakes; data on structures and their performance in seismic events; and need for disaggregation and cross analysis of data.

Attenders were also asked to give advice on how the insurance industry can be supported by the earth science community in insuring earthquake risks. A long list of suggestions was collected and is contained in the proceedings volume.

A second workshop, designed to give the insurance and reinsurance professionals the opportunity to present specific needs to the earthquake research community, will be held April 17-18, 1996.

To obtain a copy of the proceedings volume or audio tapes of the meeting, see the ordering instructions below. ♦

Jill Andrews

Below: Insurance Industry Workshop participants mingle during refreshment break.

Insurance Industry Workshop Proceedings and Audio Tapes Available

The November 9-10 SCEC Insurance Industry Workshop results and proceedings are available free of charge to participants of the workshop, and can be obtained by others (for replacement cost) through SCEC.

Audio tapes: To order, contact SCEC's Knowledge Transfer office (see below).

All tapes are fully guaranteed for exchange or refund. 1-Tape Sets (one tape per Workshop Session) are $4. Tapes may be ordered separately, or complete sets (12 tapes) may be ordered for $45 total. Shipping charges are not included.

Contact:

SCEC Knowledge Transfer
University of Southern California
Mail Code 0742
Los Angeles, CA 90089-0742
phone 213/740-1560
e-mail: *ScecInfo@usc.edu*

Selected Studies *continued from Page 10 ...*

Three Dimensional Simulation of Ground Motion in San Fernando Valley

Harold Magistrale, Steven M. Day, Gene Ichinose, Yu Guang
Department of Geological Sciences, San Diego State University, San Diego, CA

Keith McLaughlin
S-CUBED, San Diego, CA

We have developed a scalable, workstation-based procedure for 3D simulations of earthquake ground motion in the presence of very large seismic velocity contrasts. The method accommodates models with a large range of seismic velocity by using a form of adaptive gridding (recursive grid refinement). We have also developed a high resolution 3D geologic model for the L.A. region for use in the simulations, and this model has been distributed to other investigators engaged in ground motion prediction for the L. A. region.

We have completed 3 simulations of the Northridge mainshock to investigate the sensitivity of ground motion predictions to the rupture model. We have also completed simulations of 6 Northridge aftershocks, with the objective of investigating sensitivity of ground motion predictions to source location and mechanism. The simulations focus on low-frequency ground motion, with upper cutoff frequency of 0.4 Hz (one case had upper cutoff of 0.8 Hz). In all cases, maximum low-frequency horizontal velocity is correlated with depth to basement. In most cases, the predicted maxima are concentrated within the 10,000 ft. depth-to-basement contour. For a shallow aftershock outside the San Fernando Valley, the simulation also predicts high amplitudes along the nearest basin margin.

Related SCEC Publications:

193. McLaughlin, K. L., B. Shkoller, S. M. Day, and H. Magistrale, 3D Linear Elastic Finite Difference Calculations of Seismic Wave Propagation Utilizing Recursive Grid Refinement, presented *Society of Industrial and Applied Mathematics Annual Meeting,* July 25-29, 1994.
169. McLaughlin, K. L., and S. Day, 3-D Elastic Finite Difference Seismic Wave Simulations, *Computers in Physics*, in press, 1994.

Three-Dimensional Simulation of Earthquakes on the Los Angeles Fault System

K.B. Olsen and R.J. Archuleta
Institute for Crustal Studies (ICS)
UC-Santa Barbara, Santa Barbara, CA 93106-1100

We have used a 3-D finite-difference method to simulate 0-0.4 Hz ground motion from elastodynamic propagating ruptures with constant slip on faults in the metropolitan area of Los Angeles, California. Simulations are carried out for hypothetical M 6 3/4 earthquakes on the Palos Verdes and Elysian Park faults and, for comparison, an approximation to the 17 January 1994 M 6.7 Northridge earthquake. We use an elastic model (115 km by 95 km by 34 km) assembled by Magistrale and others which includes the 3-D structure of the Los Angeles and San Fernando basins.

Results show that, in general, sites associated with the largest peak motions and durations are located in the epicentral area, above the deepest parts of the basins and near the steepest basin edges. We find maximum peak velocities for the Palos Verdes, Elysian Park and Northridge simulations of 0.44 m/sec, 0.67 m/sec, and 0.58 m/sec, respectively. In each case, both the directivity of the rupture and the lower impedance of the basins significantly amplify the ground motion. Signal durations at some basin sites are beyond 90 sec due to basin-edge generated waves. The Northridge simulation reproduces the overall spatial pattern of the long-period velocities generally within a factor of two and successfully predicts the timing of late arriving waves.

URL for the WWW Page of the ICS:

http://quake.crustal.ucsb.edu/scec/pbic/pbic.html

Related SCEC publication:

229. Olsen, Kim B., R. Archuleta, J.R. Matarese, “Magnitude 7.75 Earthquake on the San Andreas Fault: Three-Dimensional Ground Motion in Los Angeles,” *Science*, December 8, 1995.

World Wide Web: Miscellaneous Information

A table of preliminary **geodetic leveling results** is now available either by WWW or anonymous ftp. A brief description of the data is provided in the distribution file:

WWW URL - ***http://aladdin.gps.caltech.edu/hudnut/hudnut.html***
anon ftp - ***tango.gps.caltech.edu /pub/hudnut/prelim.level***

Contact Ken Hudnut, USGS - Pasadena, e-mail *hudnut@seismo.gps.caltech.edu* for more information.

The National Information Service for Earthquake Engineering (NISEE) at the EERC, UC Berkeley, announced that the 1971-1983 **Abstract Journal in Earthquake Engineering** is now converted to machine-readable form. WWW URL -

http://www.eerc.berkeley.edu

Contact Katie Frohmberg, e-mail: *katie@eerc.berkeley.edu* for more information.

SCEC Scientists' Publications, Winter 1995-96

The complete SCEC scientists' publications listing is updated and available on a continuous basis. Please contact the SCEC Administrative Office, 213/740-5843, to obtain updated listings. Selected publications may be available through the Center; however, to obtain authorized copies of preprints or reprints, please contact the authors directly. The Spring quarterly newsletter includes all publications; subsequent issues will include newly submitted papers only. Publications are in alphabetical order by principal author.

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***See "Publications"** on Page 29*

SCEC 1996 Calendar

February
15 SCEC Technical Seminar, 1:00- 6:00 p.m., Crustal Deformation; contact Dr. Duncan Agnew, UCSD, phone 619/534-2590 or e-mail *dagnew@ucsd.edu*.

March
5-8 American Society of Civil Engineers, Annual Conference, "Natural Disaster Reduction '96," Washington, D.C. Call ASCE, 212/705-7496 for more information.
21 SCEC Steering Committee Meeting, 10 am - 12 noon, at Caltech. Call 213/740-5843 for more information.
21 SCEC Technical Seminar, 1 pm - 5 pm, hosted by Dr. Leon Knopoff and Dr. Kerry Sieh, "Earthquake Physics and Geology," California Institute of Technology, Dabney Lounge, Pasadena, CA 91125. Call 213/740-5843 for more information.
22 CUBE (Caltech-USGS Broadcast of Earthquakes) Users' Feedback Meeting, California Institute of Technology, Pasadena, CA. Call Karen Luethke, Earthquake Programs Office, 818/395-3298 for more information.
28-29 SCEC Advisory Council Meeting, venue to be announced. Participants: Advisory Council members and SCEC Steering Committee and Board of Directors.

April
1-3 Seismological Society of America (SSA) Annual Meeting, St. Louis, MO. For more information, e-mail *ssa96@eas.slu.edu, subject: HELP*; or, WWW URL: *http://www.eas.slu.edu/Meetings/SSA96.html*. Contact Robert B. Herrmann, St. Louis University, phone 314/977-3120 or fax 314/977-3117.
12-14 Los Angeles City Fifth Annual Emergency Preparedness Fair, the Los Angeles Zoo Parking Lot. Come and visit the SCEC Education and Knowledge Transfer Booth! Contact the City of Los Angeles Public Safety Division, 213/847-9122 for more information.
17 SCEC Technical Seminar, will the rate of large earthquakes in California increase, stay the same, or decrease over the next 30 to 100 years. We will consider seismological, geological, and theoretical perspectives on this question. In addition, we will have a special lecture, "Insurance 101," how the insurance industry works, and how it deals with catastrophes like earthquakes. Venue to be announced.
18 Insurance Industry Workshop II. Call SCEC Knowledge Transfer at 213/740-1560 for more information.
19 All-day SCEC-sponsored field trip with Dr. Thomas Rockwell, Dr. Eldon Gath, and Dr. Lisa Grant. We will inspect the Whittier-Elsinore Fault. Seating on the bus is limited—make your reservations now! Call SCEC at 213/740-1560 for more information.

May
10 Los Angeles Tall Buildings Structural Design Council Annual Meeting, Los Angeles, CA. Call Lisa Dixon, 213/362-0707 for more information.
15-17 Wharton Financial Institutions Center, University of Pennsylvania will host a conference entitled "Risk Management in Insurance Firms." Papers are currently solicited. Contact: E. Tatum, ph 215/753-5838; fax 215/573-8757; e-mail *tatume@wharton.upenn.edu*.
16 SCEC Technical Seminar: Subject and venue to be announced. Call 213/740-5843 for details.
20-24 American Geophysical Union Annual Meeting, Baltimore, MD. Contact American Geophysical Union, 202/464-6900 for more information.

July
7-10 Natural Hazards Research and Information Center Annual workshop, Denver, CO. Call 303/492-6818 for more information.
19 All-day SCEC-sponsored field trip with Dr. Tom Henyey, Center Director, and Dr. Tom Rockwell. We will tour the Palos Verdes and other offshore faults. Call 213/740-1560 for more information.
July 29-August 2 Pan Pacific Hazards Conference, Vancouver, British Columbia, Canada. Look for the SCEC poster. For more information, contact Disaster Preparedness Resources Centre, university of British Columbia, 2206 East Mall, 4th Floor, Vancouver, B.C. V6T 1Z3, CANADA. Phone 604/822-5518, fax 604/822-6164; e-mail: *dprc@unixg.ubc.ca*.

August
27-29 SCEC Site Review with Center Steering Committee and Board of Directors.

September
16-20 Western States Seismic Policy Council Annual Meeting, Polson, MT. Contact Fred Naeher, Montana Disaster and Emergency Services, phone 406/444-6982.

October
12-14 SCEC Annual Meeting, venue to be announced. 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 Rockwell. We will spend the day inspecting the Santa Barbara-Ventura area faults. For more information, call 213/74-1560.
28-November 1 Geological Society of America (GSA) Annual Meeting, Denver, CO. Call 303/447-2020 for more information.

December
6-8 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 Friday evening. Don't miss this opportunity to learn more about the largest fault in California! Call 213/740-1560 for more information.
16-20 American Geophysical Union Annual Meeting, San Francisco, CA. Call 202/464-6900. Venue to be announced.

Publications *continued from Page* 27...

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"Organization"--a classic organizational chart which shows, at a glance, the structure of the Center.
"Research"--a layer accessible through the home page and the "Mission" page, with detailed descriptions of each Working Group's research to date.

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- "Surfing the Net for Earthquake Data"

Jill Andrews

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http://www-dsed.llnl.gov/documents/WWWtest.html

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- Yahoo - Earthquakes section
http://www.yahoo.com/Environment_and_Nature/Disasters/Earthquakes
- Seismo-surfing the Internet
http://www.geophys.washington.edu/seismosurfing.html
- USGS - Menlo Park (Earthquake info, past and current)
http://quake.wr.usgs.gov/ or *http://info.er.usgs.gov/*
- Recent Quakes (with a great map viewer)
http://www.civeng.carleton.ca/cgi-bin/quakes
- Kobe shaking (color photo of shaking intensity)
http://quake.wr.usgs.gov/QUAKES/shake/kobe/kobeshake.html

Engineering and Preparedness

- NCEER (National Center for Earthquake Engineering Research)
http://nceer.eng.buffalo.edu/
- Earthquake Engineering Research Center (EERC)
http://nisee.ce.berkeley.edu/
- Structural Engineers Association of California
http://www.power.net/users/seaoc-ad/
- Earthquake Hazard Maps (ABAG Searchable maps)
http://www.abag.ca.gov/bayarea/eqmaps/eqmaps.html
- Emergency Preparedness Info Exchange
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