NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

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NCGS OFFICERS

MEETING ANNOUNCEMENT

DATE: **Wednesday, November 17, 2004**
(One Week Early Due To Thanksgiving!)

LOCATION: **Orinda Masonic Center, 9 Altarinda Rd., Orinda**

TIME: **6:30 p.m. Social; 7:00 p.m. talk (no dinner) Cost: $5 per regular member; $1 per student member**

RESERVATIONS: **Leave your name and phone number at 925-424-3669 or at *danday94@pacbell.net* before the meeting.**

SPEAKER: **Dr. Wayne Narr,**
ChevronTexaco Energy Technology Company, San Ramon

Understanding and Predicting Fractures at Tengiz – A Giant, Naturally Fractured Reservoir in the Caspian Basin of Kazakhstan

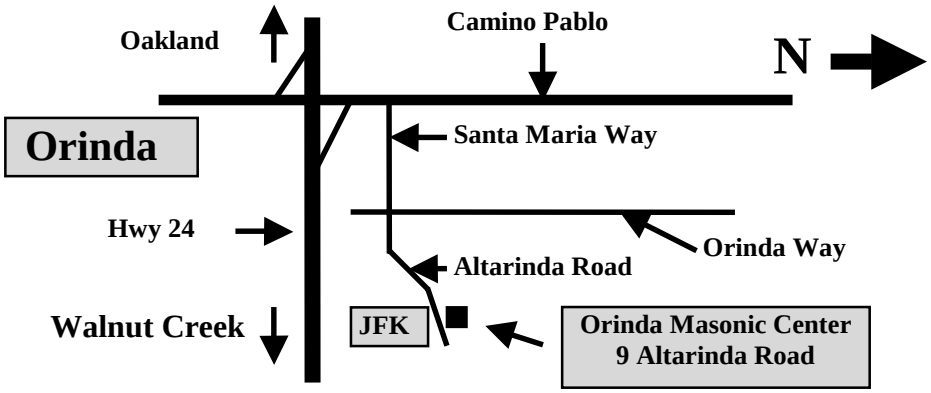
Tengiz oil field in Kazakhstan produces from an isolated limestone platform (areal extent 160 km^2) of Devonian and Carboniferous age. The build-up consists of a flat platform surrounded by an elevated rim demarking transition to the slope. Natural fractures impact producibility of the rim and flank.

Fracture characterization has two primary objectives: - A consistent, qualitative, geological conceptual model. - A quantitative model for fluid-flow simulation.

Most Tengiz fractures formed syndepositionally, related to compaction and gravitational collapse of the laterally expanding Tengiz carbonate platform. The Tengiz fractures strike parallel to the depositional margin and are in greatest abundance in the outermost platform and slope. The Permian Capitan shelf margin, Guadalupe Mountains, New Mexico, contains analogs for these fracture styles.

Fracture characterization for a flow-simulation model involves progressing from discrete fractures to effective-medium flow properties for cells. Fracture data come primarily from image logs and core. Discrete fractures are converted to fracture density logs. We use neural-net software for modeling spatial distribution of fracture properties. Various distributed properties (matrix porosity, facies, etc.) determine spatial distribution of fracture density. The approach is similar to non-linear multiple regression; the input parameters predict the output distribution. The choice of distributed properties is based on geologic

Meeting Location



knowledge.

The final step combines fracture density, geometry, and matrix permeability to compute permeability tensors for grid cells using a boundary-element model that combines the interacting effects of fracture- and matrix-flow.

Biography

Dr. Wayne Narr is currently employed as a geologist at ChevronTexaco Energy Technology Company in San Ramon, CA. His primary area of expertise is structural geology, and recently his work has focused strongly on natural fracture systems. Previous jobs include exploration for Chevron Overseas Petroleum Co., and both exploration and research positions at Gulf Oil Corporation. He earned degrees in geology from Princeton University (Ph.D., 1990), University of Toronto (M.Sc., 1978), and Pennsylvania State University (B.S., 1976).

A Reminder - Please Renew Your Membership!

Northern California Geological Society
c/o Mark Detterman
3197 Cromwell Place
Hayward, CA 94542-1209

Would you like to receive the NCGS newsletter by e-mail? If you are not already doing so, and would like to, please contact **Dan Day** at danday94@pacbell.net to sign up for this service.

NCGS 2003-2004 Calendar

Wednesday September 29, 2004
Greg Croft, Consulting Geologist
Regional Trends in World Oil Production
7:00 PM at Orinda Masonic Center

Wednesday October 27, 2004
Dr. Roland Burgmann, Univ. of California, Berkeley
Slipping and Sliding on the Hayward Fault
7:00 pm at Orinda Masonic Center

Wednesday November 17, 2004
Dr. Wayne Narr, ChevronTexaco Energy Technology Company, San Ramon
Understanding and Predicting Fractures at Tengiz – A Giant, Naturally Fractured Reservoir in the Caspian Basin of Kazakhstan
7:00 pm at Orinda Masonic Center

As Usual - No December Meeting

Wednesday January 26, 2005
Dr. Cheryl Smith, U. S. Geological Survey
Geochemical Investigation of the Distribution of* Arabis macdonaldiana *in the Josephine Ophiolite, Six Rivers National Forest, Del Norte County, California
7:00 pm at Orinda Masonic Center

Wednesday February 23, 2005
Dr. Robert Tilling, U.S. Geological Survey
Confronting Volcanic Hazards
7:00 pm at Orinda Masonic Center

Wednesday March 30, 2005
Dr. Barbara Bekins, U. S. Geological Survey
Hydrogeology and the Weak nature of Plate Boundary Faults
7:00 pm at Orinda Masonic Center

Wednesday April 27, 2005
Dr. Michael Manga, University of California, Berkeley
An Explosive Theory About Volcanoes
7:00 pm at Orinda Masonic Center

Wednesday May 25, 2005
TBA
7:00 pm at Orinda Masonic Center

Wednesday June 29, 2005
TBA
7:00 pm at Orinda Masonic Center

Upcoming NCGS Field Trips

October 30, 2004	***The Winemaker's Dance: Exploring Terroir in the Napa Valley, California*** **David G. Howell** U.S. Geological Survey
Spring (March) 2005	***Colorful Geology of the Fremont Area*** **Joyce Blueford and Paul Belasky**
Spring (May) 2005	***Robert Sibley Volcanic Regional Preserve in Berkeley Hills*** **Stephen Edwards,** Director, Tilden Regional Botanic Garden

Upcoming Meetings of Interest – Bay Area Geophysical Society

November 19, 2004
Heloise Lynn, Lynn Incorporated
AAPG/SEG 2004 Fall Distinguished Lecture

The Winds of Change: Anisotropic Rocks, Their Preferred Direction of Fluid Flow and Their Associated Seismic Signatures

Location: Stanford University, 450 Serra Mall, Stanford
Lunch: TBA
Talk: 12:00 noon, Auditorium of Building 320 (Braun Hall, Geology Corner)
Directions: Stanford School of Earth Sciences Maps & Directions
Map: Stanford University Campus [PDF]

Abstracts, biographies, directions, and maps can be found at:
http://sepwww.stanford.edu/bags/calendar

Program Chair Bill Perkins reports that the slides used by Greg Croft (September 2004 presentation) have been posted by Greg at: www.38n.net/NCGS_Talk.htm for your further edification and use. Please take advantage of this benefit if you have a further interest.

The Finer Points of Subduction on the Tiburon Peninsula

Reported by Dan Day

Weather conditions could not have been better for a field trip on September 11th when NCGS member **David Bero, P.G., R.G.**, led a geological tour of the Tiburon Peninsula. Tiburon is home to the Ring Mountain Preserve and some unique exposures of high grade metamorphic rocks interpreted to be associated with a subduction zone complex. David's excursion showcased some of the exotic rocks of this region and the complicated stratigraphy that has challenged the interpretive powers of our best geologists.

The group assembled in the parking lot of Shepherd of the Hills Lutheran Church just south of Ring Mountain, where David presented a general overview of the day's events and a geological summary of his mapping project, including a discussion of the stratigraphy and structural relationships on the peninsula. The gross structure consists of a low angle thrust fault separating a hanging wall ophiolite complex from a footwall sandstone-shale-chert-conglomerate sedimentary assemblage containing very minor greenstone volcanics. The hanging wall ophiolite is comprised of harzburgite peridotite ultramafics and serpentine-talc schist containing the large blocks of high grade metamorphic rock for which Ring Mountain is famous. The underlying sedimentary-volcanic sequence is dominated by interbedded graywacke and shale, and chert. Pebble conglomerate forms key marker horizons and greenstones are relatively uncommon. The graywacke and chert are in fault contact with the ophiolite and change dramatically as one approaches the fault contact. The normally reddish chert becomes highly fractured, microbrecciated, and silicified near the fault contact. Solution activity has bleached and recrystallized it, and bedding laminations are often complexly folded. The graywackes take on a foliation toward the fault contact, and exhibit abundant silica-filled fractures. Metamorphic grade increases from pumpellyite facies to lawsonite facies toward the contact. The latter occurs over a distance of only 100 to 200 feet. These textural and mineralogical changes are key evidence for David's structural interpretation, and aided in mapping this poorly exposed terrane. Upper thrust plate ophiolite remnants or klippe occupy the upper portion of Ring Mountain, and a NW-SE trending exposure dominates the peninsula southeast of Ring Mountain.

The oldest rocks in the terrane belong to the hanging wall Jurassic ophiolite, dated at 150 to 160 million years. The ages were taken from high temperature metamorphic blocks, and provide an age that places them cogenetic with the Coast Range ophiolite. The relationships David saw in the local high grade metamorphic terrane while living in Jenner, California, are reflected on the Tiburon peninsula. The eclogite-amphibolite-blueschist assemblage revealed here was formed at depths of about 15 to 30 km. and under high pressure in a subduction zone. As the group hiked northward up the hill behind the church, David pointed out exposures of red-bedded chert on the trail, and a distant outcrop of pebble conglomerate. The contact between the two units is apparently a fault but lateral continuity is lacking. David interprets these units, interbedded with abundant graywacke sandstone and shales, as belonging to the footwall Franciscan sedimentary-volcanic terrane. The transition from a smooth slope morphology to a blocky topography above the inferred thrust fault plane mirrors the lithologic changes from the Franciscan sedimentary-volcanic rock units below it to the ophiolite assemblage above. Rocks exposed on the trail are mildly altered medium-grained sandstones and sandy siltstones containing angular to subangular particles of quartz, albite, and biotite with secondary muscovite, chlorite, and pumpellyite (a low grade zeolite mineral). Technically, they are low grade metagraywackes.

Heading northwestward toward the third stop, the metagraywacke takes on a different character. The sediment becomes coarser, reflecting original facies changes, but more importantly, a lineation develops that becomes stronger as one continues uphill toward the fault contact. Approaching the fault contact, the fabric is cataclastic, essentially a pulverized agglomeration of crushed and elongated quartz-feldspar grains in a chlorite-white mica-quartz flour matrix. The metamorphic mineral lawsonite appears as euhedral lath-shaped crystals associated with chlorite, in a low-grade blueschist facies assemblage. The close proximity of this shear zone to the overlying ophiolite terrane implies that a very thin high P-T zone existed along the thrust plane during ophiolite emplacement. These textural features can be traced around Ring Mountain immediately beneath the ultramafic unit capping the hill.

A short distance up the hill, the group passed over the poorly exposed low-angle thrust fault contact into the hanging wall ophiolite terrane. Here the serpentine-talc matrix is exposed in sparse outcrops and the large high grade metamorphic blocks jut out of the ground. The latter span a wide range of protolith composition from cherts and sandstone/shale to basalt (greenstone). They have been exposed to high P/T conditions and converted to blueschist, eclogite, and amphibolite metamorphic facies mineral assemblages. The trip paused briefly at one of these blocks while **Dr. John Wakabayashi**, a well-known Bay Area geotechnical consultant and an expert on Franciscan tectonics, discussed its complex mineralogy. John has also been working for several decades to unravel the secrets of the Franciscan terrane. His extensive studies indicate that approximately one-third of the Franciscan is blueschist grade rock, but requires thin section microscopic examination to confirm this. The isolated high grade blocks exposed at Tiburon and along the Sonoma County coast at Jenner represent much less than 1% of the formation by volume. They are, however, excellent tectonic indicators and their mineralogy records the high pressure-low temperature and high temperature conditions they experienced during their transport down the subduction zone and during subsequent exhumation. The mineralogical assemblages exposed within these blocks and their thin outer reaction rinds range from garnet amphibolite facies through eclogite facies to blueschist facies in a pressure-temperature trajectory that traces decreasing thermal conditions, and increasing to decreasing pressures, respectively. The temperature peaked at over 650ºC and pressures reached a maximum equivalent depth of 50 km. These conditions have been replicated and confirmed by laboratory mineralogical studies conducted under controlled pressure-temperature experiments using bulk compositions identical to the protolith.

John noted that there is no silicic crustal component in the exotic high grade blocks. The protoliths are basalts and metacherts. Radiometric ages of the oldest blocks record the crystallization age of the Coast Range ophiolite. The thin (<1 foot) actinolite facies surface rinds on the blocks were formed by metasomatic reactions with the surrounding serpentine-talc schist matrix. The rinds also retain retrograde metamorphic mineral assemblages formed as the temperature declined. During subduction, the older blocks, having traveled a shorter distance from the spreading ridge, retained a shallower thermal gradient than the older ones. The most difficult question to answer is how these deep-seated rocks were brought to the surface. Exhumation probably occurred along normal faults oriented roughly perpendicular to the down-going subduction zone. The eclogites came from the greatest depth, and the metagraywackes from shallower (25 km.) depths. The rounding of the blocks occurred early in the subduction process. In the early stages of the subduction zone development, relatively young, “hot” oceanic crust is juxtaposed against high temperature ultramafic rocks in the hanging wall. Later, cooler oceanic crust is subducted, creating a steeper (greater temperature difference) thermal gradient across the subduction zone hanging wall-footwall fault contact. Conceptual models like these help researchers like John and David visualize the features they see in the field on a broader tectonic scale. John and David pointed out type location exposures of the milky white, tabular metamorphic mineral lawsonite, first characterized here and named after U.C. Berkeley geology professor Andrew Lawson. Also exposed on the rock surfaces are the green jadeitic pyroxene omphacite and the sodic plagioclase feldspar albite. These minerals are key metamorphic grade indicators used to establish the pressure-temperature conditions under which these rocks equilibrated. The high grade blocks in this area rest on intensely sheared serpentine-talc schist, less common chlorite schist, and late stage silica carbonate mineralized zones. Although the sheared serpentine-talc schist is sporadically exposed at the base of the ophiolitic terrane, it is still a functional marker horizon that is mappable throughout the peninsula.

The trail to the fifth stop led over an extensive exposure of massive harzburgite-peridotite ultramafic rocks representing the overthrusted ophiolite sheet. The trail reveals brecciated and microbrecciated cherts of the footwall Franciscan terrane in fault contact with the overlying ultramafics of the ophiolitic terrane. Either highly deformed cherts or sandstone units are the only Franciscan lithologies observed in direct contact with the overlying ophiolite. These units have been contorted, folded, bleached, brecciated, and metasomatically altered (re-silicified). They are used as markers to help identify the contact between the upper and lower thrust plates.

The trek to the sixth stop followed a south-trending drainage in a northwesterly direction along exposures of sheared serpentine-talc schist containing many high grade metamorphic blocks. Along the way the group passed clumps of spring-fed pampas grass marking the

base of the thrust fault. The sixth stop is in a saddle between the two ultramafic bodies on Ring Mountain. From the saddle, one can see several ultramafic bodies. The largest, Turtle Rock, can be seen to the southeast. It is a lenticular, rounded shape with its long axis oriented northwest. Large slabs of the outer metamorphic rind have exfoliated off the slab on its western side, and its southeastern side has broken away to expose a tightly folded interior composed of glaucophane-lawsonite-jadeite-garnet blueschist. The latter records up to seven deformation events. The surface rind is an actinolite amphibole-rich reaction zone surrounded by weathered sheared serpentine-talc schist matrix. K-Ar age mica dates of the high grade blocks from Ring Mountain are 150 million years, somewhat younger than the oldest high grade metamorphic ages (159 to 163 m.y.) considered to represent the onset of Franciscan subduction. From Turtle Rock the group followed the hiking trail upward to the southeast into the ultramafic rocks capping Ring Mountain and down slope back to the church parking lot. The view from this vantage point was a spectacular panorama of the southern Tiburon Peninsula, Belvedere Island, and the Marin Headlands-San Francisco peninsula joined by the Golden Gate Bridge.

After lunch the trip assembled on the southern Tiburon peninsula on the east limb of a large syncline that has been tightly folded into a syncline-anticline pair. Here the stratigraphy and structure are similar to Ring Mountain; an ophiolite sheet thrust over a Franciscan sedimentary-volcanic terrane along a low angle fault. The group marched uphill and crossed the east synclinal limb, traversing part of the upper ophiolite terrane into the footwall sedimentary sequence. The fault plane is marked by platy serpentine slabs protruding out of the ground, a feature common in this part of the peninsula. The trail led uphill into an altered chert that is the uppermost footwall unit cropping out on the southern peninsula. Continuing uphill, and down section, the trail crosses a narrow graywacke unit followed by a pebble conglomerate exposed along the ridgeline. These three units are laterally continuous along the ridgeline southeastward to the tip of the peninsula. Slight thickness and facies changes occur along strike, but the general characteristics continue southward and may also be present in nearby Angel Island. As the trail turns southwestward, the section repeats itself in reverse order (up section) and crosses over the low angle thrust plane into the hanging wall ophiolitic rocks. The platy “tombstone” serpentine slab structures along the thrust plane are more pronounced here and are thought to have formed during the ophiolite emplacement.

John Wakabayashi noted that the Tiburon area is actually on the northeast-dipping limb of a larger synclinal fold extending to Novato. It is comprised of several imbricated thrust sheets extending across the Bay into San Francisco. He pointed out that the simplified conventional model of younger oceanic terranes in the subduction zone complex being accreted against older ones is not necessarily observed in this region. The older Marin Headlands, for instance, was emplaced after the younger Tiburon group. This obviously complicates the tectonic history of the Bay Area -- and challenges the creativity of Franciscan structural geologists! David Bero is currently mapping on Mt. Tamalpais, which follows the structural trend of the Tiburon Peninsula. He hopes to determine if the same structural features he sees in Tiburon continue to the northwest. He also proudly acknowledges some support from Dr. Rolfe Erickson of Sonoma State University for access to thin sectioning equipment, and to Christine Rowe of U.C. Santa Cruz, who helped digitize field maps, performed X-ray diffraction analysis of field samples, and provided technical input on Franciscan geology.

The NCGS is deeply appreciative to David Bero for arranging and leading this impressive field trip to the Tiburon peninsula. David also preceded the trip with a presentation of his fieldwork at the June 30th NCGS meeting, which laid the groundwork for this activity. We all wish him well in his continuing research on the structure and stratigraphy of the Franciscan Formation.

WE'VE COME A LONG WAY, BUT WE'RE NOT THERE YET!

Presented by
Seena Hoose, R.G., E.G., H.G.; SCVWD

Ms. Hoose will pull from her vast experience as a female geoscientist professional and present key questions that are a concern to all professional Geologists. She will help her audience to define and answer pertinent questions:

- What does it mean to be a professional?
- How do women work in the profession?
- Why is the Geology profession worth saving?
- How do we ensure geological jobs for the future?

She will discuss the importance for professionals to take an active role in preserving the science. She explores the challenge of balancing career advancement and politics with professional and personal honesty and integrity. In a time when women have opportunities to hold significant positions in the Geology profession, how can they use those positions to secure the future for all of our careers?

Seena Hoose is currently an Engineering Geologist at the Santa Clara Valley Water District. She works in the Groundwater Management Unit and is responsible for the evaluation of recharge conditions. She formerly served as president of the California State Licensing Board for Geologists and Geophysicists and is currently serving on the Technical Advisory Committee for the Licensing Board. She also worked at the Regional Water Quality Control Board as an Engineering Geologist. Among many publications, Seena has authored the *Professional Practice Handbook*, published by the Association of Engineering Geologists (AEG). She also worked for the U.S.G.S. where her most well known publication is Professional Paper 993 on liquefaction during the 1906 and other earthquakes. Seena has a M.S. in Geology from San Jose State University and a B.A. in Geology from the University of California at Santa Barbara. She joined AWG about 1977.

DINNER / MEETING / PRESENTATION LOGISTICS

Location:	Washington Inn; 495 Tenth Street; Oakland CA 94607
Date:	Thursday, November 18, 2004
Timeline:	6:30 - 7:00 No Host Social and Registration
7:00 – 8:00	Dinner Meeting
8:00 - 8:45	Presentation
8:45 – 9:00	Questions and Answers

Dinner Choices:
(1) Macadamia Crusted Mahi-Mahi in a lemon butter sauce with mashed potatoes and sautéed vegetables;
(2) Fettuccini Primavera tossed in marinara with fresh vegetables and parmesan cheese;
(3) Chicken Penne Alfredo – creamy penne pasta and grilled chicken with mushrooms and asparagus.

RSVP REQUIRED:
PLEASE EMAIL RESERVATION BY 1 PM ON TUESDAY, NOVEMBER 16, 2004
with dinner choice to hollyanneo@yahoo.com

Dinner costs $30 for professionals and $20 for students.
Questions? -- Please contact Holly Orndorff at hollyanneo@yahoo.com or 510-222-2550.

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY and
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

K-12 EARTH SCIENCE TEACHER OF THE YEAR AWARD

$750 Northern California Geological Society
$500 Pacific Section AAPG
$5,000 National AAPG

Call for Nominations for the Year 2005 NCGS Competition

The Northern California Geological Society (NCGS) is pleased to announce that it will accept applications from candidates in the Northern California region for the Year 2005 competition for the Earth Science Teacher of the Year Award. The $750 NCGS award is intended to recognize pre-college earth science programs already in place, and to encourage their organization in districts where they have not been fully developed. Nominations of qualified K-12 teacher candidates are solicited from teachers, school administrators, teacher outreach programs, and other interested parties.

NCGS has joined with the American Association of Petroleum Geologists (AAPG) Foundation in presenting a $5,000 national award, to be given to a K-12 teacher for *Excellence in the Teaching of Natural Resources in the Earth Sciences.* The award recognizes balanced incorporation of natural resource extraction and environmental sustainability concepts in pre-college earth science curricula. It includes $2,500 to the teacher's school for the winning teacher's use, and $2,500 for the teacher's personal use. The award will be given at the 2006 AAPG Annual Meeting in Houston, Texas.

The deadline for application submittal by candidates for the $750 NCGS award is Tuesday, February 15, 2005.

The NCGS awardee's application will be submitted to a regional competition sponsored by the AAPG Pacific Section. The Pacific Section winner will receive a $500 award at the Pacific Section regional meeting in San Jose, California, in late April 2005, plus up to $250 toward meeting expenses and enrollment in the AAPG short course for earth science teachers, *Rocks in Your Head.* The regional winner's project will be submitted to AAPG headquarters for the national contest. The national winner will receive an expense-paid trip to Houston in 2006 to attend the national meeting and receive the award.

Interested candidates or nominators can request Application Information and an Entrant Application Form, or submit an application, by visiting our website (http://www.ncgeolsoc.org/) or contacting:

John Stockwell, Chair, K-12 Geoscience Education Committee
Northern California Geological Society
1807 San Lorenzo Avenue
Berkeley, California 94707-1840
Tel: (510) 526-5346
kugeln@msn.com

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

2004-2005 COLLEGIATE SCHOLARSHIPS PROGRAM

The Northern California Geological Society is pleased to announce the availability of two scholarship awards for the 2004-2005 academic year:

Undergraduate Scholarship Award of $500
For candidates working toward completion of a senior thesis or honors research program
Funding is provided for projects implemented during the 2005 calendar year
Application deadline is November 19, 2004 for a December 17, 2004 award date

Graduate Scholarship Award of $1000
For candidates working toward the MS or Ph.D degree
Funding is provided for projects implemented during the 2004 calendar year
Application deadline is January 31, 2005 for a March 31, 2005 award date

Interested candidates can obtain applications from our website (http://www.ncgeolsoc.org/), or from **Randy Kirby,** and they should be submitted to:

Randy E. Kirby
Chair, NCGS Scholarship Committee
67 Brookwood Road, Unit 20
Orinda, CA 94563
Voice: (925) 288-2344
Fax: (925) 827-2029
e-mail: rkirby.geosci@usa.net

Funding priority will directed to research programs focusing on topics in structural, stratigraphic, economic, engineering or environmental geology, geophysics, mapping, stratigraphic paleontology, or paleoecology, implemented within the State of California or immediately adjacent western states. Candidates will be evaluated based on submission of a cover letter requesting the award, a brief (no more than 2 page) summary of the proposed research topic, and a faculty signature confirming departmental approval of the application. Winners will be invited to speak or otherwise present their research at a regular evening NCGS meeting in Orinda, California.

Issue date: September 24, 2004