NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NCGS Newsletter Editor:
Dan Day: danday94@pacbell.net

NCGS Voice Mail: **925-424-3669**

NCGS OFFICERS

President:
Mark Detterman
mdetterman@blymyer.com

***President-Elect*:**

Field Trip Coordinator:
Jean Moran:
jeanm@stetsonengineers.com

Treasurer:
Phil Reed: philecreed@msn.com

Program Chair:
John Karachewski:
JohnKarachewski@sprintmail.com

Scholarship:
Randy Kirby
rkirby.geosci@usa.net

K-12 Programs:
John Stockwell
jpstock@ix.netcom.com

COUNSELORS

Programs:

Ron Crane
roncrane@aol.com

Barbara Fletcher:
efletcher@loving-campos.com

Don Lewis: donlewis@attbi.com

Frank Picha: afpicha@pacbell.net

Ray Sullivan:
sullivan@lucasvalley.net

Field Trips:

Tridib Guha: aars@earthlink.net

MARCH MEETING ANNOUNCEMENT

DATE: **Wednesday, March 26, 2003**

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

TIME: **6:30 p.m. Social; 7:00 p.m. talk (no dinner)**
Cost is $5.00 per person

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

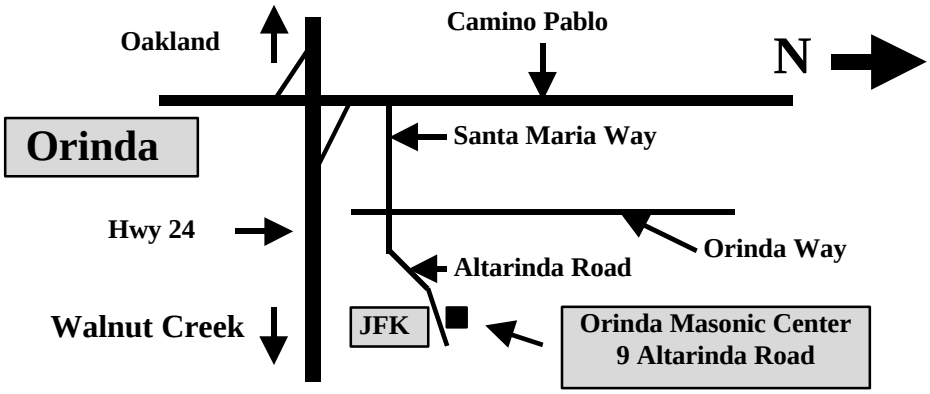
SPEAKER: **Morgan D. Sullivan**, Department of Geosciences, California State University, Chico

Fluvial-Deltaic Cyclicity, Ridge Basin, Southern California: Evidence for Kinematic Cyclostratigraphy

Upper Miocene sedimentary rocks of the Ridge Basin display a distinct cyclicity of sedimentation, which has been interpreted to reflect deposition contemporaneously with movement along the San Gabriel Fault. Observed changes in stratal stacking patterns further suggests that the units of the Ridge Basin can be divided into depositional sequences or "kinematic cycles" related to cyclic fault movement. The beginning of each kinematic cycle is marked by a period of uplift and extension related to fault movement followed by tectonic quiescence. This cyclic tectonic activity produces distinct parasequence set stacking patterns due to its influence on accommodation and sediment supply. Kinematic cycles can also vary in appearance within a given basin if relative sediment supply and accommodation are not constant, such as in the asymmetrically subsiding Ridge Basin.

On the rapidly subsiding portion of the basin, the Violin Breccia is comprised on a lower progradational interval reflecting an initial period of high subsidence related to fault movement, but extremely rapid erosion of the uplifted footwall produced more sediment than accommodation created by tectonic activity. Retrogradation of the Violin Breccia occurred in response to waning tectonic subsidence and diminishing sediment supply from the uplifted footwall. In contrast, the kinematic cycles within the Ridge Route Formation, which is derived from the less tectonically active margin, appear out of phase. Kinematic cycles in the Ridge Route Formation are comprised of a lower retrogradational interval that reflects the initial tectonic subsidence. On this less tectonically active side of the basin, however, sediment supply does not exceed accommodation. Finally, in response to waning tectonic subsidence, the members of the Ridge Route Formation prograded into the basin due to decreasing accommodation.

Continued on the back page of the newsletter



Morgan Sullivan received his undergraduate degree in 1986 from the University of California, Santa Barbara and his doctorate from the University of Glasgow in 1991. He started his career with Exxon Production Research Company in 1991 as a stratigrapher in Exxon's fluvial research group. During this time Morgan worked a variety of areas ranging from the Sacramento Valley to the North Slope to the North Sea and conducted research on fluvial and shallow marine environments. In 1996, with the focus of exploration moving to deepwater systems, Morgan joined Exxon's deepwater research team. While working exploration and production in the Gulf of Mexico and offshore West Africa, he also had the opportunity to study many of the classic deepwater outcrops around the world. In addition, he spent two years in exploration, where he was the lead stratigrapher for offshore Angola and Congo. In 2002, Morgan left the petroleum industry and joined the Geoscience Department at California State University, Chico where he is continuing his research efforts on the sequence stratigraphy of clastic depositional systems.

Northern California Geological Society
c/o Dan Day
9 Bramblewood Court
Danville, CA. 94506-1130

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 2002-2003 Calendar

Wednesday, March 26, 2003
Dr. Morgan Sullivan, California State University, Chico
Fluvial-Deltaic Cyclicity, Ridge Basin, Southern California: Evidence for Kinematic Cyclostratigraphy
7 pm at Orinda Masonic Center

April 2, 2003 **AAPG Distinguished Lecture**

Cindy Yeilding, British Petroleum
The History of a New Play: Thunder Horse Discovery, Deepwater Gulf of Mexico
2 pm in Room D2193, ChevronTexaco, San Ramon (for directions call Dan Day at **925-424-3669**).
Non-ChevronTexaco attendees will have to e-mail or phone Bob Kieckhefer of ChevronTexaco (**rmki@chevrontexaco.com** or **925-842-0511**) *no later than noon on Monday, 31st March*, to request a badge. They will have to stop at our Security Desk in the main lobby in Building A a few minutes before 2:00 p.m. on Wednesday, April 2nd, to get badges. Group will be escorted to D2193.

Wednesday, April 30, 2003
Dr. Constanze Weyhenmeyer, Lawrence Livermore National Laboratory
Reconstructing Paleoclimates using Groundwater Isotopes, Ice Cores, and Stalagmites
7 pm at Orinda Masonic Center

Wednesday, May 28, 2003
Dr. Ian Carmichael, University of California Berkeley
Topic to be announced
7 pm at Orinda Masonic Center

Wednesday, June 25, 2003
Carol Prentice, USGS, Menlo Park, CA.
***San Andreas Fault* (Exact title to be announced)**
7 pm at Orinda Masonic Center

Upcoming Field Trips…

April 12, 2003	***Field Trip to Pacheco Pass***	**Gary Ernst**, Stanford University
May 10, 2003	***Diablo Antiform-Diablo Range Intersection***	**Ron Crane**, Consultant
June 6-8, 2003	***Rodgers Creek-Maacama Step-over Area*** 2-day overnighter at Cal Academy Pepperwood Ranch west of Franz Valley	**Bob McLaughlin**, USGS, **Dave Wagner**, California Geological Survey, and others
TBA	***Clear Lake Volcanic Field***	Rolfe Erickson, Sonoma State
TBA	***Northern California Gold Belt, Quincy***	Gregg Wilkerson, BLM
Summer 2003 TBA	***Devil's Slide / Pebble beach or Pigeon Point***	Scott Morgan, Morgan & Jody Castle of Earth Mechanics
Late October, 2003	***Point Reyes Area (exact itinerary TBA)***	Tom MacKinnon

President's Report on Pacific Section AAPG, 2003

On March 26, 1925, the one-year-old Pacific Society of Petroleum Geologists became the first Chartered Section of the National AAPG. During 1924-1925, Pacific Section had a total of 97 members.

The Pacific Section AAPG of 2003 is composed of seven affiliated societies ranging geographically from southern California to Alaska. Our members include a diverse group of geoscientists working in some of the most difficult hydrocarbon producing areas in the world. We "advance the science of geology and the professional well-being of our members", as provided for in our Constitution, through the dissemination of information by way of our monthly society meetings, our bi-monthly publication *The Pacific Petroleum Geologist Newsletter*, our website and our annual convention. The Pacific Section AAPG now has 910 active members.

Consistent with our mission to disseminate information, Pacific Section is an active supporter of the publication of hundreds of geologic maps of California generated by Tom Dibblee during his lifetime. We have also led the way in establishing a core and well file repository in Bakersfield and are supporting efforts to establish a regional core repository in California.

I defined four goals I would like to accomplish during my term in office. Continuing Pacific Section's mission of disseminating information, the first goal was to enrich our community outreach by facilitating a visiting geologist program in local classrooms. The concept is to provide speaker's kits that will include a lecture outline, some visual aids and a list of reference material. It is envisioned that both active and retired geologists will be more receptive to participating in the visiting geologist program if they don't have to outline their talk or spend a lot of time searching for ideas and visual aids. Moreover, in co-operation with local educators, lectures will be tailored to supplement and to bring more student interest to existing earth science curricula.

The second goal is to provide information to help our membership inform the public about the petroleum industry. This goal is being accomplished through a *PPG Newsletter* column that provides information to illuminate misconceptions on subjects ranging from the price of gasoline to environmental compatibility of oil field operations. We also requested a similar column be carried in AAPG's *Explorer*, and are pleased to note it has appeared since last October.

Goals three and four relate to strengthening the well being of Pacific Section. Goal three is to strengthen ties with local member societies. We established a "Society in the Spotlight" column in the *PPG Newsletter* to feature articles submitted by local society representatives. These articles describe the character of their society and how it has handled important issues and contributed to the overall well being of the Pacific Section. In addition, the Pacific Section Executive Committee strives to maintain a presence with as many member societies as possible by rotating the date and location of its committee meetings to coincide with local society meetings.

Goal four is to improve corporate technical and financial support. This is an effort to renew corporate commitments to Pacific Section that have dwindled over the years through mergers and/or the disappearance of many majors from California, and a failure on the part of many current managers to recognize the benefits Pacific Section provides for their companies. This is an on-going project on which our attention will soon be much more focused.

In 2002, the Pacific Section annual meeting was held jointly with Western Region SPE in Anchorage, Alaska. The meeting was very successful, both technically and financially. In 2003, we will continue the trend of meeting with the SPE with a joint meeting in Long Beach, California. With over 160 invited or submitted technical papers and expanded opportunities for networking at a spectacular ocean setting, the 2003 convention, *LA Basin: Original Oil Field Legend*, is shaping up to be an excellent meeting.

More information is available about Pacific Section AAPG, our publications and our 2003 convention at the Pacific Section web site www.psaapg.org.

Thomas E. Hopps
President, Pacific Section AAPG, 2002-2003

Pacific Section membership dues are $12 per year. Membership inquiries should be directed to the Membership Chair, **Allen Britton** at **(661) 392-8600** or **abritton@corelab.com**.

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

Franciscan Metasedimentary Section at Pacheco Pass Field Trip

Saturday, April 12, 2003

Trip Leader:

Dr. Gary Ernst, Stanford University

Pacheco Pass represents the best exposures of stratigraphically coherent Franciscan metasedimentary section that has been exhumed from subduction depths of 20 to 30 km. this is evidenced by the presence of jadeitic pyroxene plus quartz in the metagraywackes. It is a world-class set of exposures set in a "truck rodeo" environment.

Gary Ernst received his BA in Geology from Carleton College (1953), MS in Geology from the University of Minnesota (1955) and his PhD in Geochemistry from Johns Hopkins University (1959). In 1960, Ernst joined the faculty of the University of California, Los Angeles, where he started by teaching Geology and Geophysics; becoming the chairman of the Department of Geology, 1970-1974, chairman of the Department of Earth and Space Sciences, 1978-1982, and UCLA director of the Institute of Geophysics and Planetary Physics, 1987-1989. On September 1, 1989 he moved to Stanford University for a five-year term as dean of the School of Earth Sciences. Since 1999, he has held the Benjamin M. Page Chair, School of Earth Sciences, Stanford University.

Dr Ernst has been involved in geologic mapping of the White-Inyo Range for 22 years; ultrahigh-pressure studies of the Dabie-Sulu Belt in eastern China in collaboration with Chinese, Japanese, and Russian colleagues; and research in the Franciscan Complex of the California Coast Ranges, including the early Mesozoic development of the oceanic arc(s) in the central Klamaths. His recent study of Pacheco Pass: *Chemical microstructure of Franciscan jadeite from Pacheco Pass*, was published in the California Amer. Mineral.

********** **Field Trip Logistics** **********

Time: **Saturday, April 12, 2003** Fremont Park and Ride (Hwy 238 and I-680) – **8:30 am**

Departure: Meet at the Fremont Park and Ride lot near the junction of State Hwy 238 and Interstate 680, off of Mission Blvd. (see map on next page) Parking is free. We will van pool from there to Casa de Fruita, where we will meet up with Dr. Ernst and some of his students by 9:30 / 10:00 am.

Cost: $35 for adults **(18 and over);** $15 for adolescents **(11 to 17). Cost includes transportation, refreshments, lunch, and field notes.**

********** **REGISTRATION FORM --- PLEASE RSVP by Monday, April 7, 2003** **********

Name _____ **E-mail or Fax No.** _____

Address (Street/City/Zip)_____

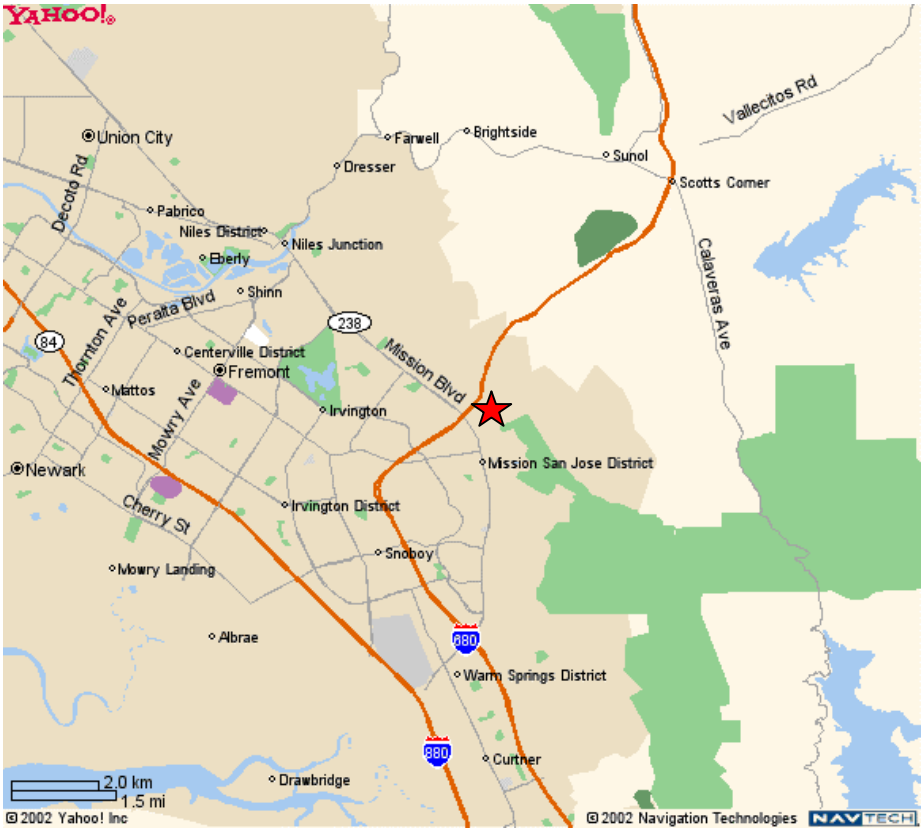
Phone (day) _____ **Phone (evening)** _____

Indicate if you are a nonmember (cost is $40) _____

Regular Lunch _____ Vegetarian Lunch _____ **(Please check one)**

Please mail form and a check made out to NCGS to: **Jean Moran, P.O. Box 1861, Sausalito, CA. 94966**

If you have any questions, e-mail Jean at **jeanm@stetsonengineers.com**, or call her at **415-331-6806** (evening)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Sierra Nevada Roof Pendants Linked to Paleozoic Deepwater Sediments in West-Central Nevada

Dr. Calvin Stevens of the San Jose State University Geology Department discussed the results of almost forty years of field work in the eastern Sierras at the February 26th NCGS meeting. Cal thrilled the audience with panoramic views of the high Sierras south of Bishop in his talk ***"Paleozoic Rocks of the Eastern Sierra Nevada and Miogeoclinal Rocks to the East."*** This definitive work on major Sierran roof pendants was done with David C. Greene of the University of Nevada, Reno. Their painstaking work has, over the years, unraveled the complex stratigraphy of these metamorphosed Paleozoic sediments, and allowed them to correlate these units with pelagic shelf sediments to the east.

Anyone who has had the pleasure of hiking the high Sierran crest will appreciate the beauty and complexity of these scattered, highly deformed and metamorphosed roof pendants. West of Bishop, the contact between the igneous granitoid plutons and calcareous sediments form tungsten ore deposits, the richest in the world outside mainland China. And the metasediments are laced with coarse-crystalline layers of grossular garnet. Cambrian through Permian strata have been identified in the pendants. The challenge was to correlate these rocks with Paleozoic strata to the east. Although Dr. Stevens had worked on these pendants since 1963, the program received a boost eight years ago when he received a grant to study this complex problem.

The research area consists of a string of pendants exposed along the eastern crest olf the Sierra Nevada Range. The key locations include the Bishop Creek, Mount Morrison, Gull Lake/June Lake, Convict Lake, Pine Creek, and Log Cabin Mine pendants. These exposures are large enough to determine important stratigraphic and structural elements of the pendants, and to provide key marker fossils. The excitement began when graptolites were found in the Pine Creek pendant that were identified as Lower to Middle Upper Ordovician. Near Convict Lake the Mount Morrison pendant provided Cambrian-Ordovician and Devonian conodont fossil locations.

Over the years Cal, David, Greene, and their student coworkers have refined the stratigraphy of these pendants into traceable units that provide important correlative links between pendants within the Morrison Block. This is especially important in light of the complex folding and faulting the rocks were subjected to during a post-Early Permian deformation event that followed the late Devonian-Early Mississippian Antler orogeny that deformed distal (distant deep water) eugeosynclinal rocks to the west. The greatest obstacle to correlating the Sierran roof pendants with Paleozoic rocks in the Inyo Range to the east was the substantial difference in lithology between the two areas. The breakthrough came in the Middle to Upper Devonian section, which represent a submarine fan complex that was funneled off the continental shelf in the Inyo Range by a major channel recognized at McGee Mountain in the Mount Morrison pendant, and its dextrally offset equivalent in the Inyos near Lone Pine.

Another significant marker unit within the pendants is the Upper Devonian Squares Tunnel Formation. It is distinguishable as a dark gray to black argillite and chert with light gray phosphatic stringers measuring a few millimeters thick and several centimeters long. The unique appearance of this unit and its widespread occurrence not only in the pendants, but also in the Inyo Range, provides a key correlative element to work with. The painstaking task of matching these lithologies between the eastern Sierras and the White-Inyo Range also involved restoring dextral fault displacement in the intervening Owens Valley. The latter is also reflected in a 65 km. dextral displacement of a strontium isotope contour ($Sr^{87}/Sr^{86} = 0.706$) measured in the exposed basement plutons. Dr. Stevens and his colleagues propose a cryptic strike-slip fault in the Owens Valley to account for the lithologic, structural, and isotopic displacement between the Sierran roof pendants similar units in the Inyo Range. Restoring the 65 km. right lateral offset provides a good match of the submarine fan facies represented by the Devonian Mount Morrison Sandstone (quartzite) at McGee Mountain. The reconstructed fan complex has its source on the continental shelf in the Inyo Range, an incised channel complex traversing the slope inbetween, and the roof pendants representing deepwater facies and pelagic deposits on the distal end of the fan. This scenario culminates a lifetime of research in a very rugged terraine know more for its scenic beauty than for the role it plays in the complex geologic puzzle of the western Basin and Range province. Unraveling this story involved solving complex structural relationships in a highly deformed and faulted area, developing good stratigraphic control with initially sparse fossil evidence, and linking various facies across discontinuous tectonic blocks to units across the Owens Valley.

The NCGS is deeply appreciative of Cal Stevens' willingness to share his forty years of dedicated field work with its members. Compilations of his work with David Greene and others can be obtained by contacting him at **stevens@geosun1.sjsu.edu**. The NCGS can provide a short list of his recent publications by calling **925-424-3669** or via e-mail at **danday94@pacbell.net**.

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NCGS Field Trip -- Silica Rich Rocks in the Berkeley Hills

By Richard Cardwell

What could be a better way to spend a warm, early spring day than hiking between the quaint neighborhood parks in the Berkeley Hills in pursuit of enigmatic silica-rich volcanic rocks? What do these well known climbing rocks look like and what are their origins? These were the questions that NCGS members and friends attempted to answer on their field trip on Saturday, February 22.

Our field trip leader for the day was Lin Murphy who studied these rocks for her Master's Degree at California State University, Hayward. We met at Indian Rock Park off Marin Circle in Berkeley where Lin gave us an overview of the day. In the morning we hiked through the neighborhood parks of Indian Rock Park, Great Stone Face Park, Hinkel Park, and Mortar Rock Park. After lunch we walked from Cragmont Rock Park to Remillard Park.

These unique rocks have been well known to local rock climbers since the 1930's. Generations of climbers have honed their skills on these rocks as they trained for the Sierra Nevadas. Notable early climbers include Dick Leonard (the 'father of technical climbing') and environmentalist David Brower.

Scattered throughout the Berkeley hills are silica-rich (up to 99% quartz) volcanic rocks. In 1914 Andrew Lawson named the rhyolites in the Berkeley Hills "Northbrae" and "Leona" after the residential areas where they crop out. He originally interpreted these rhyolites as Pliocene volcanic flows. Later the Northbrae rhyolite was mapped as part of the Leona rhyolite that is currently interpreted as part of the Jurassic Coast Range Ophiolite. However, Lin's work demonstrates that the Northbrae and Leona differ from each other in their outcrop morphology, petrology, geochemistry and age.

The most distinctive features of the Northbrae are the planar flowbanding and brecciation textures. The scales of the flowbands vary from millimeters to several centimeters, and this texture suggests that the Northbrae formed as a viscous volcanic flow. As the flow cooled, the viscous flow-bands broke into clasts (autobrecciation). In contrast, the Leona contains no flowbanding or brecciation. In outcrop appearance the surface morphologies of the Northbrae rocks are frequently rounded and in some cases are highly polished. In contrast, the Leona forms generally featureless and massive outcrops that are fractured, weathered and crumbling.

The petrology is also different. The Northbrae contains spherulites, which are radial arrays of crystal fibers that form as the flow begins to crystallize. Later most of the primary textures were silicified with feldspar being replaced by single crystal quartz and microcrystalline quartz. The Leona does not show silicification features.

The geochemistry also varies between the two rhyolites. The Northbrae has a light rare earth element (REE) enrichment in most cases and a negative europium anomaly. In contrast, the Leona shows a flat REE signature similar to the altered silicic volcanics of the Coast Range Ophiolite. The Northbrae has intermediate values for potassium and sodium, while the Leona has higher sodium and lower potassium values. The Northbrae and Leona also plot in very different fields on the Pearce tectonic discrimination diagram.

A final distinction comes from age dating. In the spring of 2002 Lin collected 150 pounds of Northbrae rock for dating, and zircons were selected from crushed rock samples. Fleck and Wooden of the USGS in Menlo Park dated the zircons from two different outcrops of the Northbrae. Uranium-lead dating yielded a late Miocene age (11.5 m.y.) for the Northbrae. The Leona is still considered to be Jurassic.

Thus it appears that the Northbrae and Leona rhyolites are distinct rock units and they have different petrogeneses. The Northbrae is now recognized as a unit of the late Cenozoic volcanics that have erupted throughout the Bay Area. These volcanics may have formed in response to the northward migration of the Mendocino Triple Junction. An alternate hypothesis is that they formed by volcanism along leaky transform faults that occur throughout the area.

For lunch we were graciously invited to the Berkeley home of NCGS member John Stockwell. John has amassed a large collection of thunder eggs from all over the world, and they fill most of the rooms of his home. The Northbrae rhyolite on Spruce Street was the source for the well-known Berkeley thunder eggs.

Thunder eggs are spheroidal nodules that are typically a few inches in diameter. Thunder eggs form in some types of silica-rich volcanic rocks such as rhyolite. As the molten volcanic lava cooled, steam and other gases trapped in the lava formed an expanding bubble. Silica minerals often crystallize around the bubble or grow crystal fibers that radiate outwards from the center. The mineral-filled bubbles with a radiating structure are called spherulites. Sometimes gas pressure can force the spherulite apart to form a central hollow that is later filled with more minerals. Later drying out, shrinkage and cracking of the silica gels or clays filling the cavity can produce the star-shaped pattern typical of many thunder eggs. Still later, silica-rich solutions may enter the cavity and fill it with banded agate, chalcedony, clear quartz crystals or even amethyst. Solutions of different composition seep in at various times, leaving behind several layers of different minerals.

The final stop of the day was at Remillard Park where we looked at an entirely different rock -- a massive outcrop weathered to a red color by iron oxide staining. Dibblee described this unit as Franciscan chert. Now, however, this unit is known to be a silica carbonate. The silica-carbonate formed by hydrothermal alteration of serpentinite. Numerous serpentinites are found in the Bay Area, and they are derived from the weathering of peridotites. Peridotites are thought to be obducted oceanic mantle. Geochemical analysis shows high levels of nickel and chromium in the silica-carbonate and is consistent with a mantle origin.

The NCGS sincerely thanks Lin Murphy for leading this excellent field trip. Her field guide can be used by NCGS members who missed this trip to conduct their own self-guided tour of these interesting rocks. Jean Moran did her usual excellent job in organizing the trip, handling trip registration, and arranging transportation. We thank to Tridib Guha for lunch arrangements. Finally, we thank all of the drivers for use of their cars and vans.

Many thanks to NCGS Past-President **Richard Cardwell** for preparing this newsletter article!