NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

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NCGS OFFICERS

COUNSELORS

MEETING ANNOUNCEMENT

DATE: **Wednesday, May 31, 2006**

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

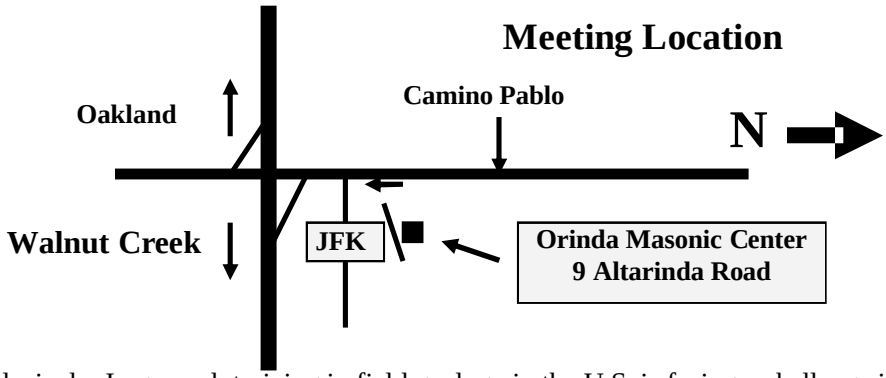
TIME: **6:30 p.m. Social; 7:00 p.m. talk (no dinner) Cost: $5 per regular member; $1 per student member**

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

SPEAKER: **Dr. George Brimhall**, UC Berkeley

Field Geology at UC Berkeley: Evolution in Methods, Opportunities, and Issues Facing Field Training Programs Today

Since Professor Andrew Lawson instituted the first field geology course at Cal in 1892, the Berkeley-Oakland Hills continue to provide a valuable natural field laboratory where geology undergraduates first acquire their mapping skills, gain confidence through systematic practice, and expand their powers of geological interpretation. This talk addresses how such field experience can still have relevance today, 104 years later. In particular, the question: How can a field area offer new challenges and opportunities after being mapped by so many generations of students? The answer is that illustrative field areas do not mature if new scientific questions continue to be posed. Furthermore, new technology is making its way into field mapping providing not only more efficient methods but ones that expand the powers of interpretation by integrating multiple sets of data including geophysics. Field classes provide a unique vehicle to integrate knowledge from diverse areas of earth science with personal experience. At Berkeley, after 5 weeks of mapping on paper topographic maps, students complete a semester's course with 10 weeks using pen tablet slate PC computers for mapping equipped with digital topographic maps, ortho-images, and card GPS units. A pen-based computer program called GeoMapper was developed at Cal to conduct mapping using the Penmap program. GeoMapper has now been introduced into other courses including structural geology and strong motion seismology. Digital overlays of seismic epicenters with geology show the faults mapped to be active, largely vertical structures indicating that the folds and faults of the Berkeley-Oakland Hills are best characterized by neo-tectonic processes. The Miocene age stratigraphic sequence is interpreted in terms of strike-slip pull apart basins, in-filled with a marine regressive sequence from Claremont, Orinda, Moraga, Siesta Valley, to Bald Peak Formations. Eruptions of MORB on land resulted in bi-modal subaerial volcanism consisting largely of voluminous basalts and minor but aerially-extensive rhyolite tuff. Continued research shows that the "Soda Rhyolite" described by Charles Palache is actually a dacite erupted from a vent facies breccia near the Space Sciences Lab on Grizzly Peak Blvd. The advanced summer field course is now taught in south west Montana to expand student's knowledge base using digital technology



exclusively. In general, training in field geology in the U.S. is facing a challenge in academia. While these field courses are viewed as being valuable to student's education and are appreciated by students, they are thought by many faculty to be time-consuming, expensive, and potentially risking in terms of liability. Like other traditional areas of earth science, faculty are being replaced by researchers in new growth areas of earth and planetary science. Hence, a declining number of faculty have the inclination and experience to teach field classes. Short term field trips in contrast to field classes are becoming the norm but are not an effective replacement. What was once considered the right of passage of a geologist may one day be viewed as an unaffordable luxury unless departments continue to staff and support field courses. The intellectual justification for their continuations is unchallenged. The issue is how to continue to offer these field-based courses while adding new programmatic areas.

Biography: George Brimhall received his BA degree from UC Berkeley in 1969 and PhD in 1972. He then worked as a mine and exploration geologist for the Anaconda Company in Butte, Montana. In 1976 he moved to Baltimore, Maryland where he started his academic career. Since 1978 he has been a Professor in the Department of Earth and Planetary Science at Cal. The courses he teaches include Field Geology and Digital Mapping, Advanced Summer Field course, Planet Earth, and Crossroads of Earth Resources and Society. His research interests include digital mapping technology, ore deposits, mineral exploration science, chemical weathering, and paleo-climate control on geological processes. Besides working in the U.S. his field work has been in South America, Australia, Africa, and Russia. He was on the Science Advisory Panel of the California Commission of Teacher Credentialing and participated in writing the Subject Matter Requirements for Single Subject K-12 science teachers. He continues to work on standards-based geoscience education reform.

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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 2006 Calendar

Wednesday May 31, 2006
Dr. George Brimhall, UC Berkeley
A History of Field Geology at UC Berkeley, and Issues Facing Field Geology Training Programs Today
(This is a lead-in to field trip in September 2006: ***Field Geological Mapping Using Modern Technology***)
7:00 PM at Orinda Masonic Center

Wednesday June 28, 2006
Speaker and Title TBA
7:00 pm at Orinda Masonic Center

Wednesday September 27, 2006
Dr. Doris Sloan, University of California, Berkeley
Dr. John Karachewski, Weiss Associates
Slide Show Lead-in to Book Publication **(*Geology of the San Francisco Bay Region*, UC Press; (http://www.ucpress.edu/books/pages/9237.html)**

Wednesday October 25, 2006
Dr. Richard Stanley, **Dr. Russell Graymer**, **Dr. Carl M. Wentworth**, U.S. Geological Survey, Menlo Park
Subsurface geology, hydrology, basin evolution, and climatic cyclicity of the Santa Clara Valley area
7:00 pm at Orinda Masonic Center

NCGS 1906 Centennial Events

May 20 – 21, 2006 Field Trip - ***Point Lobos to Point Reyes: Evidence of ~180 km Offset of the San Gregorio & Northern San Andreas Faults,*** **Kathleen Burnham**, Independent Researcher

Upcoming NCGS Field Trips

Mid - 2006 ***Panoche Hill Paleocene and Cantua Creek Cretaceous Fossil Overpressure Zone Cold Seeps,*** **Dr. Mel Erskine,** Consultant, **Dr. Hilde Schwartz,** University of California, Santa Cruz

September 2006 ***Field Geological Mapping Using Modern Technology*** **Dr. George Brimhall,** U.C. Berkeley

For questions regarding these field trips, please contact Tridib Guha at: tridibguha@sbcglobal.net

The Passing of Two NCGS Members

William Louis Hiss retired geologist and stockbroker, died Wednesday April 12, in Catamarca, Argentina. He was 75. At the time of his death, William was participating in a geology field trip. He died of natural causes. He is survived by his companion, Shela Greenlaw of Clayton, CA. Other immediate family include his brothers, George Hiss of Wichita, KS, "Gene" Hiss (deceased); two daughters: Lisa Willow of Albuquerque, NM, and Amy Hiss of Davis, CA; one son, Eric Hiss, of SF; and three grandchildren: Ben Willow, Cooper Reynolds and Finn Hiss. Bill was born in Great Bend, KS, in 1931. His parents Rosa and William Hiss were farmers during the Great Depression, which influenced him deeply. He had great respect for those who struggled against adversity and gave generously to those who he felt deserved help. He was very interested in the world around him and had diverse interests. Member of: N. Cal. Geological Society, Geological Society of America, Mineralogical Society of America and Berkeley Camera Club. He founded the William Hiss Award for "Creativity in the Earth Sciences" at CU, Boulder. He will be remembered fondly by his friends and family for his intellect, good humor, his love of natural science, his gracious manner and warm conversation. Memorial services are pending.

Published in the San Francisco Chronicle on 5/7/2006.

Former NCGS Field Trip Chairman (2000–2001) **Ernest K. Espenscheid**, a longtime exploration geologist for Chevron, passed away at his home in Danville, California, on April 20th, 2006, after a two years long battle with cancer. Had he lived, he would have been 73 on April 28th. Ernie was a first generation American, born to young German emigrants who had left Germany in the late nineteen twenties. He was born and lived his youth in the Los Feliz/ Highland Park area of northern greater Los Angeles, where he enjoyed wandering the hills of Griffith Park. Rock collecting there probably doomed him later to become a geologist. He was an only child but had the benefits of a large extended family of native Germans, some of whom were relatives, who had immigrated to the United States at the same time as his parents.

After high-schooling in Highland Park, Ernie attended close-by Occidental College to obtain a BA in Geology. Following that, and a Masters degree in Geology earned at the University of Wyoming, he joined the Exploration Department of then Standard Oil Company of California,

in Bakersfield in October, 1956. After a training regimen typical for young geologists, he was promoted in 1967 to District Supervisor, responsible for all exploration in the Sacramento Valley. A brief assignment to Chevron Overseas Petroleum followed, and then, in 1973 he was given the task, as District Supervisor, of evaluating Arctic National Wildlife and Native Regional lands in northern Alaska. In 1982 he acted as Assistant to the General Manager of Exploration, Chevron Western Region, for one year, and, in 1983, was promoted to Exploration Manager of Chevron's Alaska Division. In 1990 he transferred to Chevron Overseas Petroleum, where he worked on project evaluation and served as exploration advisor to the Indonesian operation until he retired in 1996, after completing forty years with Chevron.

Ernie loved to travel and, before and after retirement, saw a good deal of the world up close, with his longtime companion, Jane Bolton. Basically a very private person, Ernie's generous nature and candor won him a legion of loyal friends and he will be sadly missed for his forthright view of things, his honesty, and his very principled approach to life.

He is survived by his longtime companion, Jane Bolton, daughters, Ann and Krista, of southern California, and son, Eric, who lives in Florida.

*Contributed by **Jim Parkinson***

The Early Days of NCGS

*Contributed by **Don Lewis***

The very first meeting was in Sacramento in January, 1944 (contrary to the May, 1944, date cited by Kotick). Mr. Frank W. Thomas gave a talk illustrated with slides on a trip through Saudi Arabia. In a memo to all members in March, 1945, Al Solari, the NCGS president, said "At the last meeting an assessment of fifty cents was made on all members present. This is the first assessment since that made at the original meeting of the society in January, 1944." Then, "All members who have not paid are asked to enclose fifty cents in coin when returning this letter."

In June of 1944 members of the fledgling society were invited to a Sacramento meeting of ASCE to hear a talk by T. P. Pendleton, Chief Topographic Engineer of the USGS. In those early years, the NCGS meetings were mainly in Sacramento. His talk was on the new technique in making topo maps, i.e., from aerial photographs.

In a letter to Mr. Pendleton, the following chairmen of the Departments of Geology were given: Stanford—Eliot Blackwelder, Cal—N. L. Taliaferro, UCLA—U. S. Grant IV, USC—Thomas Clements, Pomona—A. O. Woodford, and Caltech—John Buwalda. These names ring any bells with you old-timers?

In a pencil summary of 1945 by E. M. Curry, Secretary, there are disbursements noted, among them $2.00 for 100 reply postcards, $8.00 for hotel and meal expenses for Dr. Louderback and $3.00 for Dr. Bullard's hotel room. Dr. Fred Bullard was the first AAPG Distinguished Lecturer to talk to the NCGS. He spoke on "Paricutin, Mexico's Newest Volcano", advertised as illustrated with Kodachrome slides and moving pictures.

Cost of the March 23, 1945, dinner meeting was $1.45 per plate, including tip.

If you would like to see an entertaining and more thorough rendition of NCGS history, see "Short History of Northern California Geological Society" by Ottmar Kotick (1976), AAPG bulletin, v. 60, p. 988-992.

NCGS Welcomes New AAPG Delegates for Northern California Region

The Northern California Geological Society welcomes NCGS member **Rusty Gilbert** and **Steve Patti** as delegate and alternate, respectively to the AAPG for the Northern California region. Rusty is employed by Chevron Energy Technology Co. as the Shallow Marine Stratigraphy Team Leader. He has been with Chevron for 26 years including Gulf Oil service. He joined AAPG in 1980. Steve Patti is employed by Chevron Corporation as an Earth Science Consultant in the Global Exploration Review Team. Previously he was the Principal Advisor for Overseas Exploration. He has been with Chevron 24 years and joined AAPG in 1982. They join current delegates **Bob Lindblom** and **Don Lewis**. The terms for current delegates **Frank Picha** and **Mel Erskine** will end on June 30. The new terms for Rusty and Steve will begin July 1 and will run for three years.

Exploring Paleocene Seafloor Cold Seeps, Panoche Hills, California

Reported by Dan Day

On October 29, 2005, **Dr. Mel Erskine** led fellow NCGS members on a field trip to examine rare cold seep-nourished biogenic carbonate outcrops on the east margin of the Central Coast Range. ***The Panoche Hills Paleocene Cold Seeps*** trip combined tectonic, structural,

and marine geological evidence to interpret these carbonate outcrops as preserved seafloor fauna.

The trip built upon research presented by U.C. Santa Cruz faculty and students **Dr. Hilde Schwartz, Dr. J. Casey Moore, James Sample, Daniel Minisini, and Kevin Weberling**. The Santa Cruz team provided Field Trip #406 ***"An Extensive Paleocene Cold Seep System: Clastic Dikes, Carbonates, and Chemosynthetic Communities in the Moreno Formation, Panoche Hills, Western San Joaquin Valley"*** at the 2005 Joint Meeting of the Cordilleran Section GSA, and the Pacific Sections of SEPM, AAPG, and SEG. Mel supplemented their studies with his own research in the Central Coast Range.

Weather conditions were drizzly and overcast as the group left San Ramon, but improved dramatically when the caravan cleared the Altamont Pass and entered the Central Valley. An hour later the vehicles exited at a vista point near Newman. Here Mel began to discuss various aspects of the regional geology that played a role in the evolution of the cold seeps.

Further south at the Panoche Hills-Firebaugh exit, Mel unfolded his maps and discussed structural relationships associated with biogenic carbonate outcrops exposed in canyons to the west. Mel has had a career as both a petroleum geologist and a geological consultant. The Panoche Hills cold seep study began as a consulting project. The work initially involved a subsurface mineral rights evaluation. Various structural aspects of the project caught Mel's interest from his prior experience in the Wyoming thrust belt. His subsurface reconstructions produced some intriguing structural discrepancies that begged for resolution. Mel pursued these problems, and developed some interesting hypotheses that dovetailed with recent interpretations of carbonate lenses in the Cretaceous-Paleocene upper Moreno Formation by the U.C. Santa Cruz team. Mel's cross sections relied in part on data from a Shell Oil well sunk just south of Pacheco Pass Road. It penetrated basement rock at 16,000 feet. The latter included a 400-foot section of untectonized andesitic volcanics. Mel interprets the latter as a remnant of the Cretaceous Sierran superstructure that sloughed off the batholith as it uplifted. About 10,000 feet of Great Valley and upper Cretaceous sediments were also included in the well core. Repeated sections implied low angle thrust faulting.

Mel explained that the Sierra Nevada is an oceanic island arc terrain accreted to the North American continent 100 to 150 million years ago. It resides about 15,000 feet above the brittle-ductile shear zone observed in seismic sections taken across the California Central Valley. The units examined during this field trip are part of an Upper Cretaceous-Lower Tertiary sedimentary basin. The shaly Moreno Formation straddles the K-T boundary and is an onlapping sequence that occurred after thrusting began. Mel noted that the Great Valley sediments are not the same in outcrop as in the subsurface. The former are 20,000 feet thick, whereas only a 10,000-foot section lies on the Sierran basement. These facts must be addressed by structural models of the eastern Diablo Range.

Profound evidence of extensive subsurface overpressure in this region was supplied by detailed (1 inch = 20 feet) sketch maps compiled by state Department of Water Resources geologists during construction of the California Aqueduct. Excavations clearly show massive fragmentation and rotation of Kreyenhagen shale blocks encapsulated by Eocene Domengine sands. Structural relationships associated with southwest-vergent low angle ramp faults and the Stockton Arch to the north is thought to have produced Domengine hydrostatic pressures that exceeded the lithostatic strength of the overlying Kreyenhagen shale. The fluidized sands were subsequently injected into the shattered shaly sediments.

Mel's experience with fluid overpressure systems goes back to his earlier work in the Wyoming thrust belt. This region was a proving ground for the thrust model introduced by M. King Hubbert and William Rubey in their classic 1959 papers on "The Role of Fluid Pressure in the Mechanics of Thrust Faulting." They invoked fluid overpressure as a means of lubricating regional low angle thrust faults to reduce frictional drag, and allow the upper thrust plate to "slide" over the footwall. Hubbert and Rubey's model provided a mechanism for explaining substantial displacements observed along many major thrust systems. Fluid overpressure is often found in tectonically active regions, and is frequently encountered in oil fields. Overpressure in the California Coast Range and in the Great Valley has been addressed by F.A.F. Berry in his paper "High Fluid Potentials in the California Coast Ranges and Their Tectonic Significance," AAPG Bulletin, V. 57, No. 7. Mel's northeast to southwest cross sections in the Panoche Hills area required a ramp thrust fault system to explain the repeated sections in the Shell Oil core.

Outcrops of fossil overpressure zones are rare, and literature describing these occurrences is equally scarce. Ironically, the Central Diablo Range contains at least three chronologically discreet overpressure systems. Mel recognized the existence of these fossil fluid overpressure zones more than a decade ago when he led a 1992 NCGS field trip to outcrops exposed along the California Aqueduct near Garzas Creek. He believes that compaction dewatering of thick shale sequences overlying well-sorted sandstones provided the pressure hydraulics for the submarine seeps that cultivated seafloor biological communities. Mel's principal contributions to the fossil cold seep model was his recognition of regional low angle ramp thrusting along the Coast Range front as a probable overpressure mechanism, and invoking seismic activity on the thrust

system to destabilize the shale units trapping the overpressured Panoche sands.

A three-mile trip westward up Esparto Canyon positioned trip participants in tilted Cretaceous-Tertiary sediments containing a fossil fluid overpressure cold seep system and the seafloor communities that it supported. Here arroyos have carved into a sandstone feeder dike network that emanates from the upper Cretaceous Panoche Formation, penetrates the shaly Moreno Formation, and terminates at the conformable sandstone lentil capping Cannonball Ridge. The cold seep sequence exposed here functioned for about 200,000 years. The Pleistocene Tulare Formation, which contains an apparent Corcoran clay equivalent correlated with the ~730,000 year-old Bishop Tuff eruptive event, is exposed in the Panoche Hills. It is flat-lying on hill crests, but to the east it dips 15º to 40º into the Central Valley. This continuous structural transition can be interpreted as a ramp thrust system that was reactivated in post-Tulare time. The horizontal ridge-top Tulare sediments located eight miles east of the Diablo Range front indicate the Range has advanced 8 miles since at least the Bishop Tuff eruption. Further north near the Livermore Valley, Tulare equivalent Livermore Gravels have been overthrust by Cretaceous sediments, again attesting to recent thrusting activity in the Central Coast Range. Uplift in the Panoche Hills area is consistent with periodic movement along a basal thrust plane 5000 feet beneath the surface. Numerous sedimentary regressions recorded by unconformities in the stratigraphic column reflect periods of active thrusting. The New Idria anticline and Vallecitos syncline to the west are part of this structural system and are on trend with a blind thrust in the Coalinga area that triggered an 11 km-deep M6.7 earthquake in 1983. Mel suspects recurring seismicity along the ramp-run (inclined) section of the thrust fault during periods of tectonic activity destabilized the overpressured sandstones and created new seeps. The low angle ramp thrust system is attributed to northwestward underthrusting and uplift as transpressional forces between the Pacific and North American plates push the Coast Range into the Central Valley. Mel peripherally noted that the Ortigalita Fault in this area is considered the "Coast Range Thrust" or Great Valley Fault, which facilitated gravity sliding of sedimentary units off the uplifting Diablo Range.

Descending into nearby arroyos, the group examined the 200 meter-thick sandstone dike and sill system feeding biological communities in the overlying Moreno Formation. The dikes and sills penetrated thin-bedded shales cross-cut by gypsum ($CaSO_4 \cdot H_2O$) seams. The Panoche-Moreno sequence represents a short-term progression from shallow water sandstones to deepwater shales. The gullies clearly revealed the feeder dikes for the overlying cold seep carbonate biological communities. The sandstone dike "plumbing" evolved over about one quarter million years in response to recurring destabilizing seismic events. The tectonically overpressured sandstones ruptured and intruded the consolidated shales, and eventually communicated with the seafloor. As connate pore fluids leaked out of the Panoche sandstones, dissolved sulfur supported a Paleocene anaerobic fauna similar to those discovered in today's offshore Monterey Bay submarine canyon. The latter are nourished by pore fluids escaping from submerged outcrops. The analogy between these modern day communities and the fossil outcrops in the Moreno Formation is striking. The U.C. Santa Cruz research team led by Drs. Hilde Schwartz and J. Casey Moore spent over 5 years characterizing the biocarbonates exposed on Cannonball Ridge before they announced their findings. Incorporating Mel Erskine's seismically-active, episodic ramp thrusting model for injecting overpressured sandstone dikes into the shaly Moreno Formation provides a coherent cause and effect model for the Cannonball Ridge cold seeps.

After lunch, Mel took everyone to a hill looking eastward toward Cannonball Ridge. Across a steep-sided arroyo sandstone feeder dikes could be seen terminating at the carbonate layer beneath the hill crest. The hilltop is a discontinuous series of carbonate mounds and pavements fed by cold seep vents. Gypsum-mantled carbonate concretions are scattered throughout the interbedded shale-carbonate horizons. Massive carbonate mounds are comprised of undisturbed bivalve and tube worm assemblages in life positions. Several densely-packed tube worm vent communities crop out on the steep westward-facing Cannonball Ridge slope. The members dispersed to closely examine carbonates exposed along the ridge crest. Mel noted that fluid overpressure sandstone dikes and carbonates are sparsely scattered throughout the Dos Palos member of the Moreno Formation. None of these features occurs in the overlying Paleocene Lodo Formation.

Looking eastward from the Cannonball Ridge sandstone lentil, Mel pointed out the approximate location of the Cretaceous-Tertiary boundary, slightly above the contact between the Marca and Dos Palos members of the Moreno Formation, and stratigraphically below the sandstone lentil. This 1 cm-thick conformable horizon contains glauconite (a clay mineral formed under reducing conditions) and phosphate debris (fish bones and small shark teeth). Elsewhere this layer is marked by altered glass spherules. No iridium-enrichment (considered a geochemical indicator of a meteorite impact that allegedly led to mass extinctions) has been found in this zone. The group made a final stop on the edge of a steep canyon south of Cannonball Ridge that exposed numerous sandstone dikes in the Moreno shales.

The Panoche Hills field trip provided a unique opportunity to explore rare outcrop exposures of what

has been interpreted as an ancient seafloor cold seep fauna. The latter closely resembles modern day biogenic carbonate communities living on sulfur and methane-bearing cold seeps/vents in Monterey Canyon. The field area is one of several sites exposed in a 20 km long belt in the Panoche and Tumey Hills. The trip offered additional input from leader Mel Erskine that tied the paleo-cold seep genesis to tectonically-driven fluid overpressure zones in the underlying Panoche sandstone/shale complex. The latter is thought to be associated with a periodically-reactivated low-angle ramp thrust system involving structures from the Coalinga blind thrust to the New Idria antiform. Sandstone dike and sill intrusions that fed the cold seeps are thought to be triggered by discreet seismic events on the ramp thrust system.

The NCGS sincerely appreciates the efforts of Mel Erskine and Tridib Guha to arrange the Panoche Hills Field Trip. Tridib handled the registration, food, beverages, transportation, and logistics. Several members provided personal vehicles for transporting people to the field sites. The writer would like to personally thank NCGS member **John Christian** for making available an April, 2004 Peninsula Geological Society Panoche Hills field trip guidebook and a 2003 Geo-Marine Letters professional article, both authored by the U.C. Santa Cruz researchers, which helped to prepare this summary.

NCGS Commemorates the 1906 Great Earthquake by Walking…the Hayward Fault!

Contributed by Dale Smith

On April 15, 2006, **Drs. Joyce Blueford** and **Mitch Craig** lead NCGS members, family, and the general public on a field trip to examine evidence of the Hayward Fault in the East Bay. The trip, as with all NCGS 1906 Centennial events was listed on the centennial website, along this reporter to discover it. The group attending the ***Tracing the Hayward Fault – A Potential Disaster Area*** field trip, met near the Fremont BART station, which amazingly is almost on the Hayward Fault, in order to follow the fault trace from Fremont to Oakland. The group met at the Math/Science Nucleus, an educational center and community service of the Alameda County Flood Control and Water Conservation District, which is located at Tyson's Pond, and is actually a sag pond. The Math/Science Nucleus provides educational opportunities for students from sixth grade through college in botany, zoology, geology, hydrogeology, paleogeology, anthropology, habitat restoration and plant propagation.

As they say in bad novels, it was a dark and stormy day. So while attendees stayed warm and dry inside, munching coffeecake and grapes, the group was told about the fault at the site and the significance of the sag pond by **Dr. Joyce Blueford**, executive director for the center. Occasionally listeners glanced outside to eye the downpour.

After the presentation Joyce invited the group to investigate the water treatment ponds. Luckily the rains had slowed to a mist and the group walked around the ponds, learning about the plants used to treat surface run-off by taking up heavy metals. From an engineering point of view, the ponds are not well built. Water is supposed to flow from pond A to B to C and then to the sag pond formed by the fault. Unfortunately, because of the crush zone caused by fault movement, the water in the treatment ponds enters the first groundwater zone and water from the sag pond flows back into the treatment ponds. In the end the water does get treated before entering the Bay, but not in the manner originally intended.

Crossing Walnut Street and heading south Joyce showed evidence of the active fault – a raised shelf adjacent to the BART parking lot. The north end of the parking lot is where the two traces rejoin each other to continue north to Hayward. There is a proposal to extend BART south to San Jose; however, it would cross the fault twice on its way south and this may prove problematic from a safety and engineering perspective. The fault does not creep in Fremont which could result in a sudden jolt as pressure is released. A meandering path through an undeveloped area followed the fault zone south. New housing developments have been recently developed on either side of this path-park, oblivious to the fault while still staying off the active trace. The path leads to the old site of the Fremont Library. Now a hillock in a park; careful observation shows it to be a scarp. So, in fact, Fremont built its library on the fault! Also in the park is an exhibit "***The Hayward Fault Exposed!***" an interpretive viewing and educational exhibit sponsored by the U.S. Geological Survey, City of Fremont, Risk Management Solutions, and Swiss Reinsurance. The Exhibit features a 14-foot-deep view of the Hayward fault. The fault is easy to see at this location and visitors are encouraged to descend a staircase to meet the Hayward fault face-to-face. At the time of the field trip, the exhibit was full of water and closed; but is now open until May 28th.

Returning to the Ecology Center at Tyson's Pond for lunch, everyone refreshed and regrouped and set off for Hayward and more evidence of the fault, under the guidance of **Dr. Mitch Craig** of California State University, East Bay (AKA Hayward). There were

several stops on the way to view evidence of creep, including a stop at Spring Drive Park, a steep scarp that has blocked groundwater flow, forcing it to the surface. At Hayward Memorial Park right-lateral offset is deforming the tennis court walls, curbs and path walls. In Hayward the dramatic highlight was Old City Hall. The actively creeping trace passes underneath the front portion of the building. The outside shows very little rupture, while large cracks are visible in the walls inside and the floor has a noticeable droop. Next door at the Veterans Memorial a subsidiary trace was very evident as a slope break in the driveway. Walking from A Street to D Street, the group viewed cracked walls and *en echelon* cracks in the ground. It was clear Hayward is being pulled apart by ground movement, yet no one seemed eager to move downtown out of harm's way. Many of the buildings were visibly bowed by the right-lateral deflection.

Then the group drove to Montclair. Just after Highway 13 branches off from Highway 580 the highway crosses the fault, placing it to the east. The fault zone is very close to Highway 13 nearly to Highway 24, when the highway crosses the fault zone again. Arriving in Montclair the evidence wasn't immediately apparent, in part because the buildings are well maintained. People stopped to ask why such a large group was wandering up and down the streets of "downtown". When it was explained that Montclair lies right over the fault, no one seemed concerned! Evidence of creep was observed in the shop walls along Mountain Boulevard and streets parallel to it. The walls of the shops had been repaired as mentioned, but the sidewalks betrayed the secret. They were torn, crumbling, and bowed by the forces below. Visiting the tennis courts just north of downtown showed more evidence of right lateral movement. To the north the fault follows the Berkeley hills and is harder to find, excluding Memorial Stadium, of course, so the trip ended in Oakland. It was a thoroughly enjoyable day for exploring the Hayward fault, a day that started out drizzly and threatening, turned warm if not sunny.

The NCGS would like to thank **Drs. Joyce Blueford** and **Mitch Craig** for taking the time to lead a very interesting field trip. The NCGS also would like to thank **Phil Garbutt** also from California State University, East Bay (and NCGS Scholarship Chair) for also speaking and making copies of the two symposia on the Hayward fault for available purchase during the field trip. And of course, the NCGS must once again thank Tridib Guha for coordinating the field trip, and providing a delicious lunch. And finally I must personally thank Clyde Warhaftig for originally sparking my interest in geology.

While most of the events related to the 1906 Centennial are winding down we thought this resource might be of continued interest to our members if they weren't aware of it.

The Bancroft Library's

The 1906 San Francisco Earthquake and Fire Website

An Online Multi-Institutional Archive

On April 18, 1906, San Francisco was wrecked by a powerful earthquake and for the next few days was consumed by fires that destroyed a large portion of the city. The earthquake's epicenter was located near the city along the San Andreas Fault. Damage from the earthquake was widespread, occurring for hundreds of miles along the extensive fault line. As San Francisco was then the West Coast's most populous city and it's leading economic and cultural center, the repercussions of the earthquake and fire throughout the region were tremendous.

Since then, documentation pertaining to the 1906 San Francisco earthquake and fire has been collected and preserved these many years at various libraries and achieves throughout the state. In preparation for the 100th anniversary of the disaster, some of these institutions have collaborated in an effort to make selected primary source materials accessible in a digital format. The 1906 *San Francisco Earthquake and Fire Project* is the result of this effort. Thousands of digital images and text files have been prepared for the project.

The website:

(**http://bancroft.berkeley.edu/collections/earthquakeandfire/**) includes an online exhibit, the ability to search and browse the collections, an interactive map of the city of San Francisco, and the presentation of a 360-degree panoramic view of the ruined city. A list of resources for further study is also provided.

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