NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

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

NCGS Voice Mail: **925-736-6039**

NCGS OFFICERS

President:
Randy Kirby
rkirby.geosci@usa.net

***President-Elect*:**
Mark Detterman
mdetterman@blymyer.com

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

Treasurer:
Phil Reed: philecreed@msn.com

Program Chairs:
Mark Detterman
mdetterman@blymyer.com

John Karachewski:
JohnKarachewski@sprintmail.com

Scholarship: open

K-12 Programs: open

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

FEBRUARY MEETING ANNOUNCEMENT

DATE: **Wednesday, February 27, 2002**

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 925-736-6039 or at *danday94@pacbell.net* before the meeting.

SPEAKER: **Dr. James G. Moore, USGS, Menlo Park**

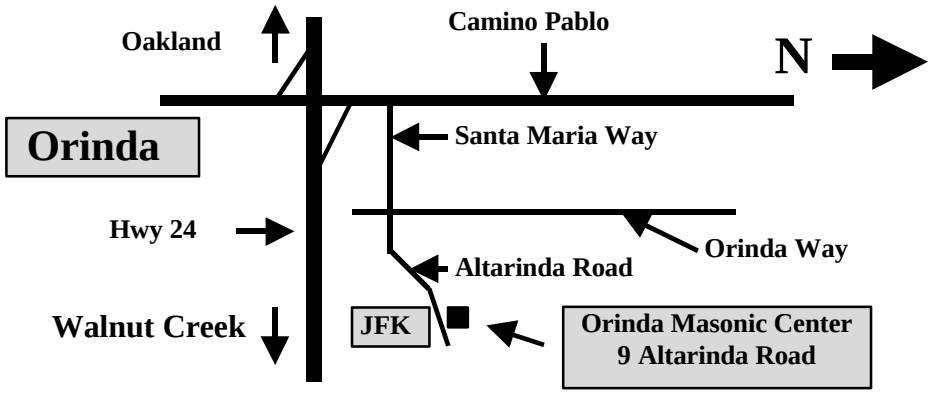
Exploring the Highest Sierra

This talk describes the first exploration and mapping of the highest part of the Sierra Nevada, particularly that region between the Palisades and Mount Whitney. John Fremont was the first to define the boundaries of the range, but much of the early work within the southern high mountains was done in 1864 by scientists of the California Geological Survey including William Brewer, Charles Hoffmann and Clarence King. They were among the first to chart the topography and identify the loftiest peaks in the country.

James G. Moore, now retired from the U. S. Geological Survey, received his B.S. in Geology from Stanford University, M.S. from the University of Washington, and Ph.D. from Johns Hopkins University. He has conducted geologic studies for several decades in the central Sierra Nevada with the U. S. Geological Survey, and this familiarity with the area motivated him to write a book published by Stanford University Press titled, "Exploring the Highest Sierra". The book weaves together the history of exploration and mapping of the range with the development of pioneering geologic concepts, such as the glacial origin of the giant Sierra canyons, and the magmatic origin of the granitic rock that dominates the range.

Jim also served as Scientist-in-Charge of the Hawaiian Volcano Observatory and has investigated about 20 on-going volcanic eruptions world-wide. He has participated in about 25 oceanographic cruises and in 50 dives in research submarines mostly to the submerged flanks of young volcanoes.

Continued on back page of newsletter



Our Apologies……

Dear members,

We've always tried our best to keep our membership records in order. But this year an error occurred that concerns us. We erroneously contacted about two dozen members regarding annual dues who had already been paid up in full for 2001-2002. We are sincerely sorry for this mistake. The job of handling the dues and keeping the mailing lists and addresses up to date takes a lot of time. And since these duties have been divided between two officers and several files, the system has been susceptible to errors. So Treasurer Phil Reed and myself are exploring a database system that will simplify our bookkeeping and greatly reduce the possibility of an incident like this recurring. Both Phil and I sincerely apologize for the inconvenience this error has caused you.

Dan Day
NCGS Newsletter editor

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 Calendar

Wednesday February 27, 2002
James G. Moore, USGS Menlo Park
"Exploring the Highest Sierra"
Orinda Masonic Center

Wednesday March 27, 2002
Donald L. Gautier, USGS Menlo Park
"The Ghost of Malthus, the Global Greenhouse, and the Perilous Geography of Petroleum"
Orinda Masonic Center

Wednesday April 24, 2002
John Gabelman, Consultant
"Hydrous Carbonatitic(?) Volcanism in Central Wyoming" (tentative title)
Orinda Masonic Center

Wednesday, May 15, 2002 AAPG Distinguished Lecture
James Harrell, The University of Toledo, Toledo, Ohio
"Archaeological Geology in Egypt: Ancient Oil Wells and Mummy Bitumen, Earliest Geological Map, First Paved Road, Pyramid Temple Pavements, and the Sphinx Age Controversy"
Orinda Masonic Center

Bay Area Geophysical Society

John Etgen of BP in Houston will talk about ***"High-end Imaging for Exploration and Development."*** Exact title TBA. The talk will be sometime this Winter or Spring 2002.

Geoffrey Dorn of BP Center for Visualization, University of Colorado will present the SEG 2002 Spring Distinguished Lecture, titled: ***"The Role of Visualization in Resource Exploration and Development."*** The talk will is tentatively set for May 7, 2002

Jon Claerbout of Stanford University is tentatively scheduled to speak this Winter 2002. The talk will most likely be at the Chevron Visualization Center in San Ramon. Please check back later for more details.

The SEG will announce a Fall Distinguished Lecture for the Autumn of 2002

Please check the BAGS website at **http://sepwww.stanford.edu/bags/** *for meeting updates.*

The Caspian Kashagan Oil Field as a Multi-Disciplinary Risk Reduction Model

In the late 1990's the hydrocarbon-rich Caspian Basin of central Asia yielded what many petroleum industry experts heralded as the largest discovery in the last 20 years. Known as the Kashagan field, it is estimated to hold between 8 and 50 billion barrels of oil in an area 75 km long by 35 km wide off the northeastern shore of the Caspian Sea. AAPG Distinguished Lecturer **William G. Zempolich** has spent several years characterizing this huge oil field for OKIOC (Offshore Kazakhstan International Operating Company). On January 14th Dr. Zempolich discussed the challenges faced by the consortium of developers in his Haas-Pratt lecture ***"The Kashagan Discovery: An Example of the Successful Use of a Multi-Disciplined Approach in Reducing Geologic Risk."***

The Kashagan field is a westward structural continuation of the late Paleozoic carbonate reef complex that hosts the large onshore Tengiz oil field in Kazakhstan. The latter was discovered in 1979 and developed by a consortium of companies that included Chevron. Many of the characteristics of that field are reflected in the much larger Kashagan play. Both are located at depths of 4 to 5 km., are overpressured, and rich (~19%) in hydrogen sulfide (H_2S), which requires special treatment to remove the sulfur. In addition to the difficult logistics of the region and its harsh winter conditions (-20 to -25ºF), the Kashagan field is located offshore in shallow, ecologically sensitive waters. The latter is driven by a lucrative $3 billion per year caviar industry dependent upon the survival of the indigenous sturgeon population. The shallow northern portion of the Caspian Sea also fosters an extensive wetland community. Preserving these natural resources was paramount to the success of this project.

The Kashagan field is located in mid-Devonian to mid-Carboniferous platform carbonate traps that are structurally continuous with the smaller Tengiz field now being produced by Tengizchevroil and a consortium of other European and Russian oil companies. The geological conditions involve late Paleozoic shale and marl source rocks beneath the carbonate platform, and evaporites above it. The carbonate platforms are analogous to today's Bahama Islands. The carbonate platform development in Devonian-Carboniferous time represented a shallowing marine environment, followed by closure of the Caspian basin and deposition of a sealing shale unit. As the basin continued to close, Permian evaporites were laid down. Permo-Triassic and Jurassic-Cretaceous clastics were deposited on the evaporite sequence, and were accompanied by salt diapirism. The geological complexity and depth of the reservoir, combined with political, ecological, climatic, and logistical constraints made this operation potentially quite risky.

The risk management program created to address these challenges was multifaceted. Since the site lies 50 to 100 km. from the nearest onshore wells that could be used for structural control, a regional study had to be developed. This included incorporating pre-1997 data (some from Soviet surveys), seismic programs, regional well log correlation, and projection of onshore data to the offshore Kashagan site. Once completed, these surveys were used to design a safe drilling program. The latter incorporated vertical seismic profiling, known drill hole stratigraphy, wire line logs, MDT pressure, biostratigraphy, sequence stratigraphy, and geochemical data. This information was correlated progressively westward from Tengiz to the Karaton, Pustennoye-Tazhigali, and Kashagan Arch. As on-site drilling progressed, the group monitored the stratigraphy by analyzing well cuttings, logging the formations while drilling, performing geophysical surveys, and creating synthetic models. The exploration team concluded that the known onshore stratigraphy could be projected offshore to the Kashagan drilling site. Subsequent penetration of the shale and marl seal between the reservoir and salt horizons was accomplished with meter-scale accuracy. The importance of the vertical seismic profiling (VSP) during drilling cannot be over emphasized, because it allowed the drillers to set the casing just before the penetrated the highly pressured reservoir.

The Kashagan East 1 and West 1 exploration wells successfully penetrated a significant late Devonian to early Carboniferous carbonate platform oil reservoir contained in third order highstand sea level sequences. This massive play is a light (45º API) oil with abundant hydrogen sulfide. It has tremendous potential, but the overall character of the reservoirs in this area and their association with the highly fractured flanks of the host carbonate platform will determine the exact size and commercial viability of the play.

The NCGS and ChevronTexaco sincerely thank Dr. Zempolich for a superb discussion of the Kashagan oil field, the largest petroleum discovery in over 20 years. This region takes on more importance in recent years with the growing conflict between the Middle Eastern oil producers and the Western Civilization consumers. Our appreciation also goes to ChevronTexaco, which underwrite much of the cost of hosting the AAPG Distinguished Lecturers, and generously provide their San Ramon Park lecture facilities for their presentations.

Moss Landing Marine Laboratory Tour and Point Lobos Sediments Highlight January 26th NCGS Field Trip

The first NCGS field trip of 2002 revisited some familiar ground covered in the March 15, 1997 field trip to the Moss Landing Marine Laboratory (MLML), the Monterey Bay Aquarium Research Institute, and the Monterey Bay Aquarium led by Dr. Gary Greene of MLML and Dr. Debra Stakes of MBARI. Last month's trip visited the newly constructed Moss Landing Marine Laboratory, replacing the facility damaged in the 1989 Loma Prieta earthquake. This trip was again expertly led by **Dr. H. Gary Greene**, California State University at MLML. It showcased the tremendous work he and his associates have gone through to replace the old facility with a state-of-the-art marine laboratory serving the California State University system.

Those of us who attended the March 1997 trip can appreciate the effort that went into planning and executing the vision of the new Moss Landing Marine Laboratory. The reconstructed facility was funded by FEMA, and it represents a functional, well-equipped research facility that made optimum use of the government relief funds. Dr. Greene ensured that the facility did not overlook any of the essentials, and had the students' best interests in mind when he and his staff designed the new research campus. The facility is very well laid out and comfortable. It has all the necessary amenities, including data ports for laptop Internet access, a complete machine shop, specimen tanks, and archived storage facilities. Yet one senses that each dollar was thoughtfully applied to its objective.

Approximately 120 students from around the California State University system are enrolled in class at MLML. About eight universities in the CSU are represented on campus, mostly from the greater Bay Area and Central Valley. The student body is about half biologists and half marine geologists. The staff includes biologists, ichthyologists, phycologists (marine plant specialists), and physical oceanographers; many of them former colleagues from the USGS. The MLML offers students a Masters degree in Marine Science. There is a Center for Habitat Studies, which utilizes geophysical techniques to characterize the sea floor. This information has been tied into a project with the Alaska Department of Fish and Game to help control commercial fishing operations. Other research projects underway at MLML include characterization of tsunamigenic (tidal wave generated) landslides, sediment transport mechanisms, bio-erosion, and a grant to study the southern California borderland. As the group was escorted by Dr. Greene through the one-tenth mile long one-story complex, he noted that the facility had been relocated after the 1989 Loma Prieta earthquake to its present spot on a marine terrace overlooking the Salinas River as it enters the Moss Landing harbor. The land rests on an Indian midden site, which required relocation of grave sites. Now the lab occupies 14 acres and an Indian burial site 7 more. The latter will be expanded to include a small museum describing the local Indian culture.

The facility has a spacious library that overlooks the Salinas River slough and numerous fully-equipped labs, but it does not have a dormitory complex for students. Hence any given class is conducted for a full day once a week to minimize commuting time. An added benefit is the close proximity of the Monterey Bay Aquarium Research Institute (MBARI) funded by the Lucille and David Packard Foundation. MBARI was established by Hewlett Packard co-founder David Packard to fulfill his dream of establishing a "Woods Hole of the West" for marine research. A portion of its funding has gone to design technology specifically for underwater research. Two ROV's (remotely operated vehicles) are used to explore the deep canyon that begins only a few hundred feet offshore. Dr. Greene fully funds eight of his students, and has allocated funding to defray the cost of student research excursions on the MLML and MBARI vessels. In addition to the two ROV's, scientists take a manned submersible to depths of 300 meters. The state allocates $1 million annually to MLML, most of which goes to staff salaries. Dr. Greene has also approached private firms, who have cooperated with MLML as industrial associates. These companies allow MLML personnel to trial their new equipment. After touring the MLML facilities, the group headed with Dr. Greene to view MLML and MBARI research vessels docked in the Moss Landing marina, then took a brief tour of MBARI and an annex where Dr. Greene and his students conduct applied offshore biohabitat studies for commercial fishing regulation. Inclement weather forced the group to take lunch indoors, and then everyone headed to Point Lobos for the final leg of the trip.

Point Lobos State Reserve is located a few miles south of Carmel on Highway 1. It features superb exposures of the Eocene Carmelo Formation and its interbedded proximal to distal deepwater submarine fan sandstones and cobble conglomerates. The NW-trending fan deposits lie unconformably on the Monterey Group granodiorite porphyry. The latter has been correlated with a remarkably similar granodiorite unconformably overlain by cobble conglomerates and sandstones that crop out north of San Francisco at Point Reyes. Work by various scientists suggests displacements of 115 to 185 km. between Point Lobos and Point Reyes along the

San Gregorio and San Andreas faults. Hence, this location is a key piercing point that allows an estimate of displacement and rate of movement along this fault system. The fan deposits are a classical turbidite assemblage displaying sandy to shaley Bouma sequences interbedded with coarse cobble conglomerates exhibiting rip-up clasts, flame structures, load casts, graded bedding and other sedimentary bedforms. Some of the beds have undergone post-depositional deformation, which has upturned the layers to expose seaweed imprints and trace fossils caused by bioturbation. Dr. Greene feels that the finer-grained distal end of the fan represents submarine channel overbank deposits that formed when a plume of fines drifted away from the canyon mouth. The volcanic clasts in the conglomerates are not from a source in general area. They likely came from a southerly source and were transported northward when tectonic motion of the Pacific Plate with respect to the North American Plate shifted from a subduction regime to the current right lateral transpressional strike-slip movement in the Pliocene. Dr. Greene also speculates that the Monterey submarine canyon originally formed in the Miocene as a southern outlet of the California Central Valley. It experienced periodic episodes of uplift and erosion alternating with burial and partial filling as it migrated northward along the San Andreas strike-slip fault system to its present location. The sediments exposed at Point Lobos are marvelous examples of Bouma A through D turbidite sequences, easily accessed by trails along the shoreline. They are well worth seeing, and can make a pleasurable one-day outing from most parts of the San Francisco Bay Area.

The NCGS sincerely thanks Dr. Gary Greene for taking time from his busy schedule to lead a tour of the new Moss Landing Marine Laboratory facility and a short field trip to Point Lobos. His contribution to our field trip program is greatly appreciated. Thanks also go to **Jean Moran**, NCGS Field Trip Coordinator and her husband, Bill, for organizing the trip and providing transportation. Treasurer **Phil Reed** arranged for a van and provided breakfast coffee and donuts, and **Dan Day** procured lunch and beverages. Those interested in learning more about MLML can go to its website at **http://www.mlml.calstate.edu/.** A website link to regional geologic sites of interest, designed in a field trip format with excellent color pictures, can be accessed from the MLML home page by selecting Research Groups, Geological Oceanography, then Regional Geologic Sites of Interest, or by simply going to the URL **http://www.mlml.calstate.edu/groups/geooce/rgnalsts.htm**. A geological guide to the Point Lobos State Preserve is included in this group of field trips.

Environmental Impacts of Lode Gold Mining Highlight January 30th Meeting

Lode gold expert **Dr. Roger P. Ashley** of the USGS, Menlo Park, spoke to NCGS members on ***"Lode Gold Deposits of the Sierra Nevada and Their Environmental Impacts"*** at the January 30th meeting. Roger has over 35 years experience studying precious-metal and base-metal deposits in the western United States. In recent years, his focus has turned to characterizing the geochemistry and environmental impacts of gold deposits, with emphasis on the Sierra Nevada.

Gold has been recorded in over 8000 mines in California, mostly in the northern Sierra Nevada and Klamath Mountain Ranges. The Sierra Nevada is a world-class gold-mining province that has yielded roughly 2800 tons of gold since 1848, of which 1000 tons was produced from lode ores. California's gold-mining history is rich. It began with surface placer mining in the late 1840's, and was joined by hydraulic mining in the 1850's. Hydraulic mining sopped abruptly after passage of the landmark Sawyer Decision in 1884 which prohibited any mining operation that added tailings to the state's rivers. Lode mining operations were in their infancy at this time, but rapidly became a key source of gold in the Sierras. Dredging became established in the 1890's and continued through the 1970's. Significant lode gold mining ended in the 1940's. Since 1848 California has produced 34% of the gold in the U.S. or 3% of the world total.

There are more than 4000 lode gold mines in California with recorded production, but only 25 mines yielded 70% of the total recovered lode gold. About 50% of the cumulative lode gold take had been accomplished by 1910. The lode ores occur mostly in metamorphic rocks of the western Sierra Nevada foothills. The famous Mother Lode ore belt occurs along the Melones Fault zone and the Bear Mountain fault between Georgetown and Mariposa. Further north is the Grass Valley-Nevada City district, the largest in the state, and the Jackson-Sutter City district. All districts are structurally controlled by faulting. The ore deposits are low-sulfide gold-quartz veins (orogenic gold deposits) and the ore bodies are quartz-carbonate veins that cross-cut hydrothermally altered metamorphic and plutonic host rocks. The veins contain a few percent pyrite (FeS_2), arsenopyrite (FeAsS), and arsenian pyrite, plus traces of chalcopyrite ($CuFeS_2$), gold, galena (PbS), and sphalerite (ZnS). Ores can often contain over 1000 ppm arsenic. Hence a major environmental and health concern is arsenic in the tailings piles. The latter can be a

significant part of the sediment load in some drainage basins.

Mercury in the mine tailings was also a concern since elemental mercury had been used in the stamp mill battery boxes where the ore was crushed, and on the amalgam tables where the pulverized ore "pulp" was spread to recover the liberated gold particles. The crushing process also formed mercury "flour," an emulsion in the water that allowed some of this amalgamating agent to escape downstream. Estimated mercury losses from lode mining operations is 1100 tons, and losses to tailings before 1890 is estimated to have been from 6 to over 20 grams per ton.

Load-gold mill tailings that were generated before 1912, when the state required them to be impounded, are now in the drainage system, and contain ~65% of the mercury lost. The onset of cyanidation as a gold recovery process in the 1890's greatly reduced mercury losses and arsenic levels in tailings by 1910. The remaining tailings should contain <3 ppm mercury and <1000 ppm arsenic. After 1935 the stamp mills and amalgamation process were gradually phased out.

Surveys conducted in lode mining regions have shown that although elevated levels of mercury and arsenic (on the order of parts per trillion and ppm, respectively) have been found in drainage waters from adits, tailings, and pits, the downstream watersheds show low levels of these elements. Unlike mercury, which can enter the biological food chain, it is thought that arsenic is readily adsorbed onto iron oxyhydroxides and removed from the hydrosphere. Lode-gold mining created 152 million metric tons of high-arsenic tailings, and the volume of tailings is significant in some watersheds. The post 1912 impounded tailings pose physical and health hazards, and have been used as fill for commercial building sites. However, the impacts on water quality and on the populace are significant locally, but the regional impact is small. The impact of mercury, because of its ability to enter the food chain, is considered much more serious than that of arsenic, which tends to remain close to the tailings source.

The NCGS expresses its thanks to Roger Ashley for completing its series of three talks on the effects of historical gold mining in California on the environment. Roger spent some time after his presentation discussing his views of arsenic and mercury contamination from mining on the environment, and elaborated on many of the techniques used by the miners. He left his audience with the comment that to accurately evaluate the effects of mining on a regional scale, one must consider its history and the ore processing techniques used in addition to characterizing the mine wastes.

Biggs Award For Excellence In Earth Science Teaching For Beginning Professors

Purpose: To reward and encourage teaching excellence in beginning professors of earth science at the college level.

Eligibility: Earth science instructors and faculty from all academic institutions engaged in undergraduate education, who have been teaching full-time for 10 years or less. (Part-time teaching is not counted in the 10 years.)

Award Amount: An award of $750 is made possible as a result of support from the **Donald and Carolyn Biggs Fund**, maintained by the GSA Foundation, the GSA Geoscience Education Division, and GSA's Science, Education & Outreach Programs. This award also includes up to $500 in travel funds to attend the award presentation at the GSA annual meeting.

Deadline and Nomination Information: Forms for the 2002 Biggs Earth Science Teaching Award can be located at **www.geosociety.org** or by contacting **Leah Carter** at **(303) 357-1037** or by email at: **lcarter@geosociety.org.**

Nominations must be received by May 1, 2002.

Mail Nomination Packets to:

Leah Carter
Program Officer Grants, Awards, and Medals
Science, Education & Outreach
The Geological Society of America
P.O. Box 9140
Boulder, CO 80301-9140, USA

mailto: **lcarter@geosociety.org**
(303) 357-1037

GRA Sponsored Symposium

Perchlorate, NDMA, and Other Groundwater Contaminants from Aerospace and Rocket Fuel Facilities

April 17, 2002 at the Radisson San Gabriel Valley

The Groundwater Resources Association of California is developing the Fourth Symposium in its Series on Groundwater Contaminants -- "Perchlorate, NDMA and Other Groundwater Contaminants from Aerospace and Rocket Fuel Facilities". The Symposium will be held at the Radisson San Gabriel Valley on April 17, 2002.

The investigation of aerospace facilities where rocket fuel has been used has revealed the presence of several highly recalcitrant contaminants in groundwater, particularly perchlorate (ClO_4) and NDMA (N-nitrosodimethylamine). These chemicals have been found to impact drinking water aquifers in California, leading to the closure of numerous municipal water supply wells (refer to the California Department of Health Services web site at http://www.dhs.ca.gov/ps/ddwem/chemicals/NDMA/NDMAindex.htm for an overview of NDMA in California's drinking water). Other sources of these compounds have been identified and include wastewater treatment processes, fertilizer usage, rubber and textile manufacturing, metals refining and finishing and automotive air bag manufacturing.

Information about the use and behavior of these chemicals is not abundant. The Fourth Symposium will showcase experts and offer up-to-date knowledge on the occurrence and potential sources of NDMA perchlorate, their fate and transport characteristics, regulatory status, toxicology and chemical detection challenges. The program will also provide information about the known impact on water resources from these compounds, current remediation/water treatment options. In addition, the program will address other critical issues surrounding rocket-fuel contaminants in groundwater.

The Symposium will consist of the following four sessions:

SESSION 1:
Occurrence and Characteristics: Potential Contaminant Sources, Geochemistry, Fate and Transport in the Subsurface

SESSION 2:
Toxicity, Chemical Analysis Methodology and Regulatory Standards

SESSION 3:
Perchlorate and NDMA in California San Gabriel Valley (Water Supply Impacts, Sources, Responsible Parties Actions, Water Supply Treatment, Agency Activities)
Sacramento Area (Historical Sources, Regulatory Interaction, Water Supply Impacts, Litigation)
Remediation and Treatment Alternatives

SESSION 4: Regulatory and Legal Status
Regulatory Status (Agency Responsibility and Interaction)
Impacts to Municipal Water Supplies (Regulatory Response, PRP Litigation, Toxic Tort Lawsuits)

Hotel Information

Radisson Hotel San Gabriel Valley
14536 Baldwin Park Towne Center
Baldwin Park, CA 91706
Toll-Free: 1-800-333-3333
Tel: (626) 962-6000
Fax: (626) 962-1053
http://www.radisson.com/baldwinparkca

The Radisson Hotel San Gabriel Valley is conveniently located approximately 20 minutes from the Ontario Airport, 40 minutes from Los Angeles International Airport and just 20 minutes from downtown Los Angeles. In-room amenities include daily maid service, coffee makers, irons, ironing boards, hair dryers and data ports. The Hotel features elevator key access, heated pool and spa, 24-hour exercise room, business center and free parking.

GRA will also coordinate a pre-Symposium site visit of a perchlorate water treatment facility in the San Gabriel Valley area the day before the Symposium. For additional information about the Symposium, please contact GRA Executive Director, Kathy Snelson, at 916/446-3626. Updated program information will be posted to this page. If you would like to receive automatic Symposium updates by email, sign up for GRA's email distribution list email distribution list.