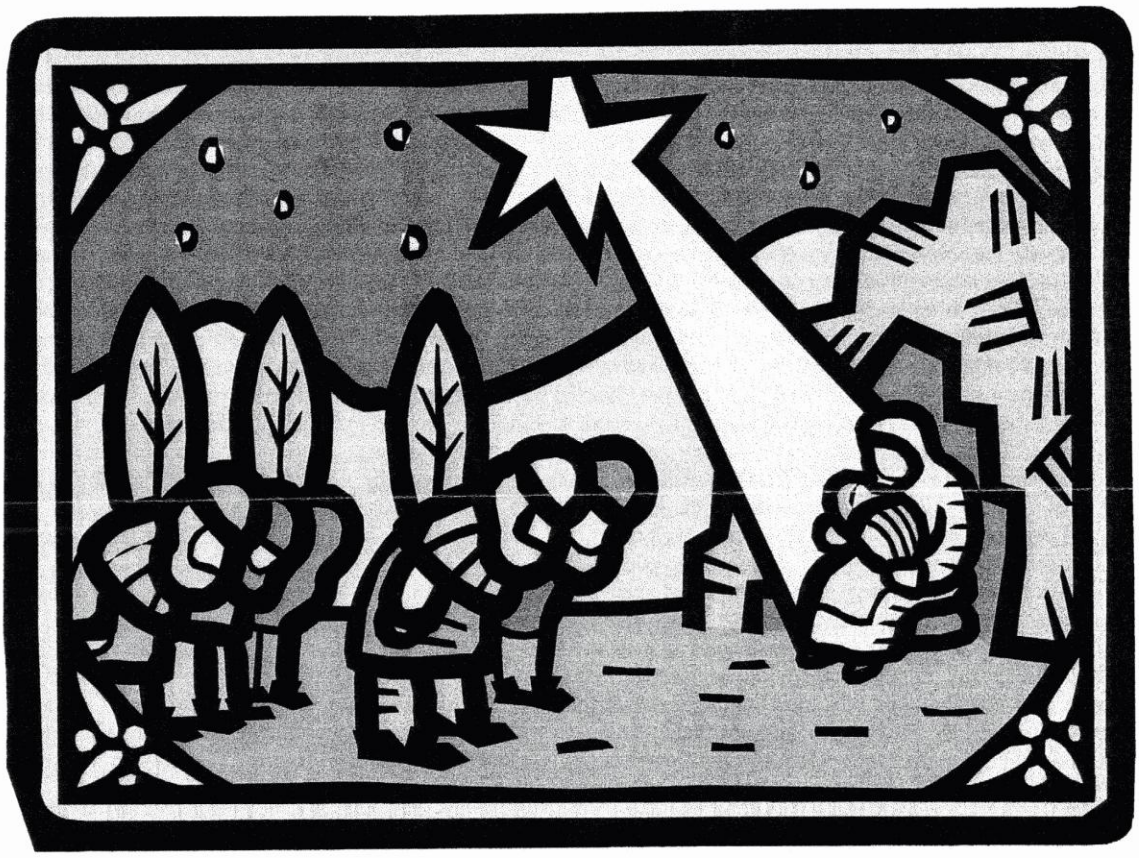
Holiday Greetings



From the Officers of the

NCGS

Tephrochronology Featured As An Important Dating and Stratigraphic Tool On October 16th NCGS Field Trip

The NCGS was extremely fortunate to get **Dr. Andrei Sarna-Wocjicki** and **James P. Walker** of the U.S. Geological Survey Tephrochronology Laboratory in Menlo Park to lead a one-day field trip to examine Neogene volcanic ash deposits in the East Bay Hills. The October 16th event was blessed with excellent weather conditions and completed the 1999 NCGS field trip season in a grand fashion.

Tephrochronology is the science of dating and correlating volcanic tephra, or air-fall volcanic eruptive events, to establish chronostratigraphic control in sedimentary sequences. Dr. Sarna-Wojcicki is a pioneer in this field, and has been using this technique to fine-tune Bay Area stratigraphy, to correlate nonfossiliferous sediments and sedimentary facies, and to determine an absolute time scale based on datable volcanic eruptive events. His initial contribution to this field was his doctoral thesis work at U.C. Berkeley in the late 1960's, and he has continued to refine and expand his work in this field for the last 30 years. Tephrochronology has a multi-faceted appeal in that it introduces one to the fascinating field of geochronology and to a forensic style of petrographic and geochemical "fingerprinting" techniques that allow one to date and correlate various ash layers over wide distances. The information gleaned from these studies provides insight into the frequency of volcanic activity in the Bay Area over time, and can be used to pinpoint the ultimate eruptive sources of the tephra. The fortuitous consequences of these eruptive events, which essentially form time horizons in the sedimentary record, is their usefulness in unraveling the complex sedimentary stratigraphy in the Bay Area, particularly where key fossil evidence is absent.

The trip itinerary would take the group from just south of Livermore near Del Valle Reservoir to the Los Medanos Hills just south of Pittsburg on the shore of Suisun Bay. A fifth stop was scheduled for a location just east of the Carquinez Strait to an eruptive center at the southeast corner of the Sonoma Volcanic field that was a source of some of the Neogene tephra layers to be examined that day. As the group headed east on I-580 toward Livermore, Andrei pointed out the low hills just north of the freeway that form the northern edge of the Livermore Valley. These hills are underlain by the poorly exposed non-marine Pliocene Tassajara and Upper Miocene Sycamore Formations. As the vehicles exited and headed south on North Livermore Avenue they crossed over Las Positas Creek and viewed a the convex profile of a late Pleistocene stream terrace that has been interpreted as geomorphic evidence for continued recent deformation along bedrock anticlinal structures. South of Livermore the vehicle crossed the sinestral Las Positas fault trending NE-SW which separates the Plio-Pleistocene Livermore Gravels from Quaternary alluvium to the NW. It connects with the dextral Greenville Fault to the NE, and with the Williams and Verona thrust faults to the SW. The two pyroclastic deposits are exposed in a roadcut along Arroyo Mocho a short distance from the entrance to Del Valle recreational park where Mendenhall Road intersects Del Valle Road. The terraces exposed along the arroyo have been uplifted along the northern Diablo Range rising to the south. The tuffs are ~3 meters (lower) and ~1.8 meters thick, separated by about 7.6 meters of fine to medium-grained stream sands and alluvial gravels of the Sycamore (Tassajara) Formation underlying the coarser-clasted Livermore Gravels. The lower tuff unit is identified as the Lawlor Tuff, dated at 4.83 m.y., and the upper unit as the 4.71 m.y. old Huichica Tuff. Both are water-lain and have been correlated by petrographic and chemical techniques with other tuff units in the Bay Area, and with units encountered offshore in the Pacific Ocean by the Deep Sea Drilling and Ocean Drilling Projects. The dates given were performed by the Ar^{40}/Ar^{39} technique and are a refinement of older, possibly contaminated K/Ar ages.

Andrei gave a detailed description of the neutron activation, x-ray fluorescence, and electron microprobe techniques used to establish the trace and minor element histograms of the glass shards from tephra that is used as one of the tools to correlate various pyroclastic deposits over great distances. Petrographic examination and trace element analysis of glass shards indicate the lower tuff is associated with the type Lawlor Tuff in the Los Medanos Hills to the north and was erupted from a vent not far from the type locality at the southeastern end of the Sonoma Volcanic field. Layers of the Lawler Tuff have been found as far south as the western Los Angeles basin, and as far north as Alturas in northeastern California. Sedimentary and stratigraphic features at this locale suggest the tuffs were deposited when the Diablo Range, the source of the alluvial fan and stream deposits interbedded with the tuff units, was topographically lower than it is today. The overlying Livermore Gravels, with their coarser clasts, attest to an uplifted and higher energy source to the south in Plio-Pleistocene times. Before leaving for the next stop, the group examined an exposure of Franciscan ophiolitic pillow basalts in fault contact with the Sycamore Formation.

The vehicles traveled northward across I-580 and took county backroads across the Tassajara (Rasmussen) anticline and the Sycamore Valley (Highland) syncline to an exposure of the Roblar Tuff off Camino Tassajara east of San Ramon and Danville. The tuff is water deposited and reworked and dips vertically in this outcrop. It is situated in the upper Sycamore Formation and has been chemically correlated with the 6.25 m.y. old Roblar Tuff from its type area in the marine Wilson Grove Formation near Petaluma and Sebastopol. It has been correlated with tephra units exposed north and south of San Pablo Bay, in the Berkeley Hills Block near Lafayette, and in Deep Sea Drilling

Project cores taken in the Delgada Submarine Fan off Cape Mendocino. These various exposures and the sediments bounding them suggest a distributory drainage system flowing roughly east to west through alluvial, lacustrine, estuarine, shallow marine, and shelf marine environments as a single time-line event. Dr. Sarna-Wojcicki posed a palinspastic reconstruction of the greater Bay Area and offshore Mendocino coast back to 6.25 m.y. ago that he used to estimate displacements along the San Andreas Fault system since this time. The apparent offset across these faults yields partitioned displacement rates along the San Andreas, Hayward, Calaveras, and other faults that is consistent with those derived by independent techniques. The only complication is the necessity to place some motion along the Tolay or a similar now inactive fault segment to account for the total amount of apparent displacement over this time interval. Details, details! However this may also be telling us something about the displacement history of this complex fault system.

The third stop was at Shell Ridge Recreational Area west of Mt. Diablo in Walnut Creek. The ridge is a prominent outcrop of the lower Cierbo Formation, and the Shell Ridge Open Space itself is underlain by units from Eocene to Pliocene age. The ridge to the south across Indian Valley from Shell Ridge is composed of Neroly Formation volcanolithic sands. The sands are mostly derived from andesitic sources. Jim Walker is studying the sedimentology and provenance of these units. A this stop he described the lithology, sedimentology, and paleoenvironment of the Neroly at this location. The Neroly is correlated with the volcanic Mehrten Formation in the northern Sierra Nevada Range. At Shell Ridge both the Cierbo and Neroly Formations have Sierran sources (provenance) for the sand size fractions, a dissected volcanic arc for the Cierbo, and an active arc source for the Neroly. Sources were more heterogeneous for the Cierbo than the Neroly, but both indicate their sources were not Franciscan on the east side of the Calaveras Fault. Paleocurrent studies suggest the Neroly on this side of Mount Diablo was from a Mehrten-type source in the northern Sierras, whereas the unit in the Livermore area contains a Franciscan component and paleocurrent directions that imply the Diablo Range deflected the Sierran fluvial system in this area to the NNW. The group examined quarry outcrops of the Neroly Formation. The Lawlor Tuff has been identified in the overlying Green Valley/Tassajara Formations, and provides key stratigraphic data to help correlate and identify outcrops of this unit around Mount Diablo. This has been an important tool for Jim's on-going study of the quite variable Neroly facies relationships in the East Bay region.

Stop four was at the Alves Construction Company quarry in the Los Medanos Hills just south of Pittsburg. Here the Neroly Formation (called the Cierbo by some) unconformably underlies the Lawlor Tuff. The Los Medanos Hills are an asymmetrical anticline bounded on the southwest by the Clayton and other faults that may be associated with detachment faulting. A cross section of the fold from SW to NE reveals a thick section of Tertiary sedimentary rocks: the Eocene Markeley Formation, the Oligocene (or perhaps Miocene?) Kirker Formation (these are mostly SE of Bailey Road which cuts across the anticline), the Miocene Cierbo and andesite-derived Neroly Formations, the 4.8 m.y. Lawlor Tuff, and the Los Meganos Gravels (the Wolfskill Gravels or Tehama Formation) dated as 3.5 m.y. old to upper Quaternary in age. The Alves quarry walls slice through excellent exposures of laminated sediments, graded bedding, and textbook examples of cross bedding. It is close to the contact between the Neroly and Cierbo Formations. The Cierbo contains abundant pelecypod (clam) and gastropod fossils, whereas the alluvial Neroly produces some outstanding petrified wood specimens. The group trekked uphill to the south to examine some of the fossiliferous Cierbo beds and entered the lower Cierbo (Briones) Formation where a tuff unit correlated with the Roblar unit of stop three is exposed. The Neroly in this area is tephrochronologically (supercalifragilistically?) dated at between 9.8 to 11.1 m.y., although it can encompass a much broader time range than this, especially at the younger end. As the group climbed up Hill 566 (to the northwest of the quarry, Andrei pointed out some faulting displacement at the Lawlor Tuff-Neroly unconformity. The lower Lawlor Tuff in this location is a clast-supported air-fall tuff deposited directly on the subaerial Neroly erosional surface. The upper Lawlor Tuff in this outcrop is a matrix-supported ash-flow tuff. The size of the pumice fragments indicates close proximity to the eruptive center. From this vantagepoint the group could survey Suisun Bay and the lower foothills to the north (up section), where Andrei has found the 3.4 m.y. Putah Tuff near the base of the Los Medanos Gravels. This volcaniclastic deposit crops out near the base of the Tehama Formation further north in Yolo County near Putah Creek, which exits from Lake Berryessa.

As the day was growing short, the fifth stop across the Carquinez Straits was cancelled, but the guidebook has directions to this 160 meter-thick outcrop of pumice lapilli-lithic ash-flow tuffs chemically identical to the Lawlor Tuff. The Lawlor Tuff is absent west of the Coast Ranges and in deep sea cores, suggesting that winds blew eastward and that there was no connection westward to the ocean at this time. The GreatValley at this time was a large integrated drainage basin that emptied into a marine embayment extending a cross the Kettleman Hills and Temblor Range that connected to the ocean near to and north of the present Monterey Bay. Evidence for this is the occurrence of the Lawlor Tuff at the top of the marine Etchegoin Formation in the Kettleman Hills. Andrei concluded with a discussion of the age range of Sonoma volcanic activity (~8 m.y. to ~2.5 m.y. ago), and a poster session of Alan Bartow's reconstruction of the Central Valley and Coast Range at 7 m.y., 4 m.y., and 600,000 years ago. He also

described the glacial Lake Clyde (Central Valley) which ultimately breeched the Carquinez Straits and exited through the Golden Gate, post-dating the Salinas Valley-Monterey Bay drainage of the Central Valley. His discussion also included descriptions of San Francisco Bay ~125,000 years ago and lower sea level stands that left the Farallon Islands high and dry 20,000 years ago.

This excellent field trip merits a longer narrative, and produced a guidebook that no doubt will be coveted by field trip enthusiasts. Dr. Sarna-Wojcicki and Jim Walker went through considerable effort to produce an itinerary that has an easy-to-follow road guide to five premier volcaniclastic outcrops in the East Bay, easily done in one day. Some stops will require notification of landowners and county facilities for access. We thank Dr. Sarna-Wojcicki and Jim Walker for leading this superb trip to examine these tephra deposits and to discuss their association with various complex Neogene sedimentary units in the Mount Diablo area. This guidebook can be purchased from the NCGS by calling the newsletter at 925-294-7530.

This trip ends an extraordinarily active field trip season by the NCGS, all planned and executed by Field Trip Coordinator **Bill Howell**. Bill has provided the NCGS with an outstanding series of events that included four trips into the Diablo Range, a look at the largest landslide in the Bay Area led by a renowned landslide expert, a sojourn up Pleasanton Ridge for the annual family picnic, a unique raft trip down the American River to view the Mesozoic Sierra Foothill terranes, and an introduction to East Bay tephrochronology by a leading expert in the field. Bill certainly deserves credit for planning this exhausting schedule and handling all logistic, transportation, and registration duties. We thank member **Sandy Figuers** of Norfleet Consultants for driving one of the vans, and **Cesar Luga** and his staff at Nob Hill Foods in San Ramon for preparing the lunches. Stay tuned for next year's NCGS field trip schedule!

Meteorite Impact Craters the Topic at the November 10th NCGS Meeting

The forty attendees at the November 10th NCGS meeting were given a double treat that night. In addition to **Richard Blake's** talk ***"3-D Seismic and the Discovery of California's First Meteorite Impact Crater, Sacramento Valley"***, they were fortunate to have **Bill Fisher**, President of the Santa Clara Miners Association, display his personal meteorite collection from outings he has made to the Gold Basin meteorite impact site in Nevada. Bill works in construction but has an interest in searching desert areas for gold and meteorites. Gold Basin is so named because gold nuggets can be found at or near the surface there. It was also the site of a meteorite shower impact. Bill periodically travels to this area, located midway between Kingman, Arizona, and Las Vegas, Nevada, to search for meteorites and gold with his metal detector. Meteorite researchers on the staff of the University of Arizona, Tucson, are monitoring the site. Bill contributes to their survey by providing carefully plotted maps of locations where he has discovered meteorites. He uses GPS to fix the sites and has experimented with various models of metal detectors to find systems that are sensitive enough to respond to meteorites at the surface or in the soil underfoot. About 2,000 meteorites have been found in this area; Bill himself has found 46, and exhibited some of them in handsome display cases at the meeting. He plans to return to the area soon to continue his search for more meteorites, which takes a certain amount of prospector's savvy, a knowledge of meteorite distribution patterns in the valley, and skillful operation of a metal detector.

Richard Blake of the Environmental Restoration Division at Lawrence Livermore National Laboratory is a hydrogeologist, environmental geologist, and a gas and petroleum exploration consultant with over 17 years of experience in the California gas exploration business. He has spoken to the NCGS before, most recently in September, 1997, with a talk on oil and gas exploration in the Meganos Submarine Canyon near Brentwood, California. This presentation is an offshoot of 3-D seismic exploration work he was involved with southwest of Sacramento. The company was surveying a 42 square mile area off the Yolo Bypass looking for gas fields in Cretaceous sandstones. The survey was focusing on the Winters sandstone unit, an accumulation of sands from channels to the east that coalesced to form a 2,000 foot deep turbidite section that ultimately yielded five gas fields. The survey was shot on a 300 foot grid, and yielded a fascinating circular-shaped feature in the Cowell sand. Computer software analysis of the seismic data allowed the surveyors to isolate the structure, examine its topographic features, construct a structural map, and come to the preliminary conclusion that it resembled a meteorite impact crater.

The structure was named the Cowell Crater after the S.H. Cowell Foundation which owns the property that overlies the subterranean feature. It is about half the size of the famous three-quarter mile-wide Barringer Crater near Winslow, Arizona, which was formed by a meteorite impact about 50,000 years ago. The Cowell Crater is Miocene age and was calculated to have been formed by an object about 50 to 100 feet across that impacted at a velocity of about 10 miles per second. The collision ejected an estimated 100 million tons of debris and would have been equivalent to a 10-Megaton explosion, or 1000 times greater than the Hiroshima atomic bomb blast. The site was subsequently covered by sediment runoff from the Sierras. The finer structure of a meteorite impact, such as

overturning of layered sediments around the crater perimeter, cannot be seen in the seismic data. These features have been well chronicled by detailed studies of the Barringer Crater and meteorite impact modeling by NASA. The Cowell site has been pierced by several wells, but well log data do not conclusively confirm an impact origin for the site, and cuttings were not taken. Several other Miocene-age impact craters have been discovered in North America, suggesting that the earth may have passed through a major meteor shower at this time.

Modeling studies and close examination of recent meteorite impact sites show an evolutionary sequence of crater development that progresses from the initial impact to a steep-walled transient crater stage, followed by subsequent collapse of the crater walls and a central upheaval event, erosion and faulting modification, and eventual burial. The remainder of Richard's talk centered around other craters discovered in North America: the 6.5 mile-diameter upheaval dome in southeast Utah formed in Jurassic times and studied by Walter Alvarez and colleagues at U.C. Berkeley; the oil-producing Ames Crater in Oklahoma, located 10,000 feet below the surface and formed 470 million years ago; and the enormous 180 mile-diameter Chixalub Crater in the Yucatan that was created 65 million years ago. Walter Alvarez at U.C. Berkeley has analyzed volcanic sediments from the K/T (Cretaceous/Tertiary) boundary and found much higher than average iridium (Ir) levels, an element with relatively high concentrations in meteorites. Alvarez uses major meteorite impact(s) and their effects on atmospheric and climate conditions as the cause of massive faunal extinctions across the K/T boundary.

Another key interest in buried meteorite crater sites is their amazing affiliation with oil deposits. Of 17 known meteorite impact sites, 9 are producing oil. At Ames, Oklahoma, the Silurian-Ordovician impact site is producing oil from 40 wells. The Chixalub Crater in the Yucatan produces large quantities of oil and gas and has estimates reserves of 20 billion barrels of oil and 15 trillion cubic feet of gas. The brecciated impact structures are excellent oil and gas reservoirs, and their complex structures acts as traps for migrating hydrocarbon fluids. The current finds are driving exploration of other known impact structures as potential gas and petroleum plays.

Richard ended by noting that the asteroid belt between Mars and Jupiter, which is considered the spawning ground of most meteorites, contains an estimated 2,000 objects greater than 1 kilometer across and 300,000 objects over 300 feet in diameter that regularly cross the earth's orbit. Only ~10% of the large meteorites or asteroids have been discovered, posing the question "where are the other 90% predicted by scientists?" According to some experts, meteorite impacts are a real risk and, like earthquakes and other acts of nature, will inevitably occur. Accurately predicting these collision events, however, is not within our current scientific capability.

Our sincerest thanks to **Richard Blake** for returning to address the NCGS on the fascinating topic of meteorite craters in the geologic record. His unique career experiences have enriched our knowledge of local gas and oil geology, as well as of the unique extraterrestrial impact events that periodically scar the surface of our planet. Many thanks also go out to **Bill Fisher** of the Santa Clara Miners Association who provided physical evidence of meteorite falls and described research efforts by the University of Arizona that are attempting to understand these phenomena. This presentation concludes the NCGS monthly speaker agenda for 1999 arranged by Program Chair **Randy Kirby**.

Bay Area K-12 Teachers Celebrate Earth Science Week at Black Diamond Mines

Thirty Bay Area earth science teachers celebrated National Earth Science Week (October 18-22) by participating in a workshop hosted by the NCGS and the East Bay Regional Parks District at the Black Diamond Mines Regional Preserve near Antioch on Saturday, October 23rd. The teachers were treated to lectures that described the geology, wildlife, and history of the preserve, which was the site of California's largest coalfield and five flourishing mining towns during the late 19th Century. The seminar lasted from 9:00 a.m. to 5:00 p.m., and was offered as a one-quarter unit California State University Hayward credit to those interested in this option.

The group convened in the Hazel-Atlas Mine to hear introductions to the East Bay Regional Parks programs by Tilden Nature Preserve naturalist **Margaret Kelly**. She described numerous workshops and field trips sponsored by the EBRPD for the public to attend. **Ray Sullivan** followed with another entertaining slide presentation that introduced the teachers to the last 50 million years of central California geological history. Ray has some excellent slides showing color schematic representations of Central Valley evolution since early Tertiary time, with particular reference to the units that were mined at Black Diamond Mines. The latter involved the Eocene Domengine Formation, which was deposited in the supratidal, intertidal, and subtidal zones of a widespread estuarine complex that occupied much of the San Joaquin-Sacramento Valleys at this time. These sandy sediments are part of the Sierran runoff that was associated with placer gold deposition in tributaries that drained the young range. Ray detailed some of the sedimentary features associated with each zone in prelude to the mine tour, which would expose some of these structures in the mine walls. Also discussed were post-San Andreas tectonic activity, the Coast Range uplift, and the transition from off-continent subduction to strike-slip faulting along the San Andreas fault system. Ray gave present

day analogies of the various geological processes that shaped the continental margin during this time interval, and throughly entertained the audience with his wit and humor.

Ray was succeeded by EBRPD ranger **Tracy Parent** who is quite knowledgeable about Black Diamond Mines history. The area first gained notoriety in the 1850's when coal was discovered. Coal mining commenced in the 1860's as miners sought the lignite grade fuel resource in thin beds that extend for about 10 miles along a narrow curved belt on the north slopes of Mt. Diablo. The five mining towns that grew up in this district—Nortonville, Somerville, Stewartville, West Hartley, and Judsonville—were inhabited by about ten nationalities, the dominant group being Welsh miners and their kin. The largest town, Nortonville, at one time had about 1000 citizens, and housed miners of the largest mine, the Black Diamond Mine after which the preserve takes its name. Somersville was near the mine facilities open to the public, and maintained the Rose Hill Cemetery with its rich history and quaint gravestones. Three miles to the east lay the third largest village, Stewartville, and the small communities of West Hartley and Judsonville were further to the east. Tracy showed slides taken from old pictures of the towns, their inhabitants, and the miners of the time. She chronicled their social events, their everyday lives, and the tragedies that befell those associated with the risks of coal mining. Most of the old structures have been destroyed, but a few survive as park offices or managed to be preserved for us to enjoy. These mines provided Sacramento and the greater San Francisco Bay Area with ~4 million tons of coal for heating and power generation, shipped out by railroad or barge at the nearby ports of Pittsburg and Antioch. Ultimately the coal from this region was replaced by better grades shipped in from South America, and by the turn of the century, all the mines had closed. The mining towns were deserted and those few who stayed behind became ranchers. In the 1920's Marvin Greathouse reopened the district to the mining of the Domengine sandstones, a high purity glass grade sand deposit. This activity continued into the late 1940's, and provided the tunnel passages that EBRPD ranger **John Waters** and his crew restored for the public to enjoy. The property was purchased by the EBRPD in the 1970's, who closed the mines that were public hazards

Following the presentations, ranger Steve Muller, Mine Supervisor, took the teachers on a tour of the Hazel-Atlas Mine. There they were instructed in the basic terminology of mines, how they are constructed, and historical / technical aspects of sand mining at this site. The group was then taken on a short walk at the surface to illustrate how the geology of the area has shaped its current landscape. The teachers returned to the nearby public picnic area to enjoy a delicious barbecued lunch of marinated chicken, pork chops, sausages, Spanish rice, breads sticks, and salads prepared by **Tridib Guha** and his wife **Mita**. **Phil Reed** and **Dan Day** were the designated grill-meisters. Afterwards Tracy took the group to the Rose Hill Cemetery, and Ray Sullivan commented on lithologic changes in the Domengine as the hikers crossed over the contact between the brownish calcareous sands and the whiter (and purer) sand units that were mined for their glass sands. At the small graveyard, Tracy described the unfortunate acts of vandalism that have marred some of the original tombstones, and talked about the value of old pictures to help pinpoint some of the grave sites. The teachers were divided into small groups and given newspaper obituaries to guide them to a specific grave. Subsequent articles filled in historical data about the deceased, and gave everyone an idea of the lifestyle and social behavior of these 19th Century mining towns. This exercise also poignantly revealed some of the tragedies, epidemics that claimed small children, and even scandalous behavior of the inhabitants. Tracy noted the importance of old photos, public records, and the newspapers as tools for piecing together the fascinating history of now abandoned town sites. The view from the cemetery was breathtaking, and was complemented by clear skies and balmy breezes. This exercise ended the day's activities. A good time was had by all, many of whom were delighted at being able to explore the geology, wildlife, and mining history behind this facet of California's past.

The NCGS sincerely thanks K-12 Committee Chair **Randy Kirby** for acquiring the databases used to mail notification fliers to the Bay Area's earth science teachers. Special recognition goes to **Ray Sullivan**, Professor Emeritus at San Francisco State University, who has spent decades studying the geology of the Black Diamond Mines, and who did a phenomenal job of creating a slide show presentation geared towards the K-12 instructor level. NCGS President **Don Lewis** was also active both at the function and behind the scenes coordinating the NCGS-EBRPD joint function. The **East Bay Regional Parks District** deserves accolades for handling major portions of this event, for arranging CSUH educational credit for the teachers, and for providing their own staff instructors to cover the various mining and historical aspects of the workshop. **Tracy Parent** handled the history of the mining district and its citizens, **Margaret Kelly** spoke on educational programs available to the public through the EBRPD, **Steve Muller** and his staff led and supervised the underground mine tours, and naturalist **Bob Kanagaki** lent his knowledge and expertise whenever needed. And let us not forget the now legendary culinary skills of **Tridib** and **Mita Guha**, who prepared many of the lunch dishes enjoyed by the attendees. His recipes and marinating sauce were requested by several of the teachers. **Phil Reed** and **Dan Day** were delighted to help him with the barbecuing, which produced delicious results with the chicken, pork chops, and sausages.

A Note of Thanks to Our Officers

During the Holiday Season it is always good to reflect on the year's activities and thank those who have worked to keep the NCGS an active society. This year saw another excellent series of monthly meetings with talks ranging from Global Climate change and lessons learned from recent flooding in California to fossil evidence for the evolution of birds from dinosaurs and the contributions of soil tectonics to paleoseismic research in the greater Bay Area. Members **John Karachewski** and **John Sciacca** gave entertaining presentations on a pictorial Geo-travelogue from Colorado to Hawaii, and on the hydrostratigraphic analysis of a complex fluvial depositional system near Sacramento, respectively. We heard experts from the USGS, Menlo Park, speak on the geology and pre-San Andreas location of the Gualala Block north of Point Reyes, and on the seismicity, tectonics, and volcanic activity in the Long Valley Caldera. **Douglas Dreger** of the U.C. Berkeley Seismological Lab titillated us with computer re-enactments of Bay Area strong ground motion reconstructed from actual seismic data. And **Gary Greene** of the Moss Landing Marine Laboratory and the Monterey Bay Aquarium Research Institute provided exciting underwater pictures and beautiful maps of the Monterey Bay submarine canyon when he spoke on fluid flow, unique biological communities, and mass wasting in the canyon at our June meeting. And although the AAPG Distinguished Lecture program met with some unforeseen scheduling snags, we managed to salvage a superb talk on the application of Ichnofacies (trace fossils—shrimp burrows) Analysis to petroleum exploration and reservoir management by **Dr. George Pemberton** of the University of Alberta, Canada. **Dr. David Jones**, renowned expert on the structural evolution of western North America spoke on tectonostratigraphic terranes of the Alaskan and Californian Cordillera. **Dr. Ben Santer** of LLNL discussed evidence for human influences on recent climate change, and **Richard Blake** gave a lecture on meteorite impact structures in the geologic record, accompanied by **Bill Fisher's** personal meteorite exhibit at the November meeting. Most of this was deftly orchestrated by Program Chair **Randy Kirby**, who handled this duty as well as this year's K-12 program. Randy deserves our appreciation for taking on this office. The Fall 1998 schedule was arranged by then President-Elect **Don Lewis**. Both men did an outstanding job at this post, which is not without occasional moments of anxiety!

Not to downplay the hard work of other officers, but many of you will agree that the 1998-1999 Field Trip program was exception in both scope and variety. We owe all of this to the tireless efforts of field trip ultra-enthusiast and Vice President/Field Trip Coordinator **Bill Howell**. Bill was first sited on the April, 1998 Sutter Buttes field trip, where he volunteered to handle the next year's field season. Little did we (or Bill) know what lay in store for us in the coming months. The field season began with the March 6th Brushy Peak excursion near Livermore, part one of four field trips through the Northern Diablo Range, three led by **Ron Crane** and the fourth by **Mel Erskine**. These trips provided important insight into the tectonic history and structural style of relatively recent orogenic processes in the Coast Range. Sandwiched between these jaunts were an extremely well-attended trip to examine the Mission Peak landslide in Fremont led by landslide expert **David Rogers** of Geolith Consultants, a family picnic with a short instructional lecture and hike to see important features in the Livermore Valley by **Patrick Hubbard** of Treadwell & Rollo, and an exciting whitewater rafting trip down the South Fork of the American River to examine the local geology led by **Dr. Russ Graymer** of the USGS, Menlo Park. This exceptional agenda ended with a well-attended trip led by **Dr. Andrei Sarna-Wocjicki** and **James Walker** of the U.S. Geological Survey, who explored tephrochronology (ash eruption events and their absolute dating) as a tool for unraveling the complex sedimentary stratigraphy in the greater Bay Area. Our thanks go out to Bill for providing up this marvelous program, and for coordinating the food, logistics, and registration duties involved with each event.

Behind the scenes, 1999-2000 President **Don Lewis** is taking a hard look at the NCGS finances in an attempt to give everyone the best for their dues dollars. He is being ably assisted by Treasurer **Thelma Dana** and Membership Secretary **Judy Hayes**. Both have extensive experience with handling society monies and maintaining large databases. So we are in good hands, and will be carefully watching our treasury as we work to expand our public and member services in the next millenium. Judy was preceded by **Clark Fenton**, who did much to improve our handling of annual dues and the member database.

In addition to acting as Pacific Section AAPG representative and Secretary of the CCGO, Past President **John Karachewski** has established a website for his geologic photographs at **www.geoscapesphotography.com**, while taking on a new job with Weiss & Associates at the Lawrence Livermore National Laboratory. John's photography is outstanding and has been extensively used as cover photos for major geological magazines and on flyers for an assortment of geological conferences. Some of his pictures were taken on NCGS field trips.

Now we enter a new millenium, not without some technological intrigue and apprehension. But we can safely assume the NCGS is in good hands, and that the organization will continue to grow and serve Northern California geoscientists with its programs and field trips. Merry Christmas and a Happy Y2K New Year from all of us!

NCGS Member Receives Michel T. Halbouty Human Needs Award

The Pacific Section AAPG recently informed the NCGS that member **Thomas L. Wright** will receive the ***Michel T. Halbouty Human Needs Award*** at the 2000 AAPG Annual Meeting in New Orleans. This honor was bestowed on Tom in recognition of the efforts he has made toward the preservation and application of petroleum seismic and well data to the discovery and mapping of earthquake faults in the Los Angeles Basin. Tom is a renowned expert on the geology of the Los Angeles Basin, and has devoted much of his time since retiring from Chevron towards this important project. He has also been a long time active member in the NCGS, and co-led the ***Late Cenozoic Geology of the North Bay Region*** field trip with paleoseismologist David Schwartz of the USGS in May, 1992. Please join all of us in congratulating Tom for receiving this distinguished award.

Boy Scouts Seeking Rock Specimens

A group of Southern California Boy Scouts is seeking a contact willing to provide them with identified rock samples. Individuals who are willing to help with this project, or who know of someone who might be able to assist the scouts, please e-mail **Rachel Fischer** at **rafrag@aol.com** for more information.

Northern California Geological Society
c/o Judy Hayes
453 Scotts Mill Rd.
Danville, CA. 94526-4234