

# NORTHERN CALIFORNIA GEOLOGICAL SOCIETY



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## NOVEMBER MEETING ANNOUNCEMENT

**DATE:** Wednesday, November 10, 1999

**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 on the recorder at 925-294-7530 anytime before the meeting.



**SPEAKER:** Richard G. Blake, Lawrence Livermore National Lab and Consulting Petroleum Geologist, Pleasanton, CA.

### *3D Seismic and the Discovery of California's First Meteorite Impact Crater, Sacramento Valley*

The first meteorite crater ever found in California was discovered as a buried feature in the Sacramento Valley, about seven miles southwest of the City of Sacramento. The crater is about 4000 feet in diameter and lies 2400 feet below ground surface. It was located using a 3D seismic survey intended for natural gas exploration. The crater has been formally named the Cowell Crater, after the S. H. Cowell Foundation which owns the property where the discovery was made. The Cowell Crater is approximately half the size of the Barringer Crater near Flagstaff, Arizona, a surface crater that was made about 50,000 ago. Studies by the USGS suggests that a meteor of this size would eject about 100 million tons of rock by the impact of a meteor between 50 to 100 feet in diameter. The impact would be equivalent to a 10 megaton explosion, or 1000 times bigger than the atomic bomb that was dropped on Hiroshima during World War II. The meteor would have struck at a speed of about 10 miles per second, which is fast enough to cross the continental United States in two or 4-5 minutes. The meteorite smashed into the ancestral Sacramento River flood plain during Miocene time about 25 to 30

*Continued on the back page of the newsletter*

## 2000 Western Regional Meeting

The **Pacific Section of the American Association of Petroleum Geologists (PSAAPG)** and the **Society of Petroleum Engineers (SPE)** are "Working In Concert" and invite you to submit an abstract for presentations to be given at the **Western Regional Meeting (WRM)** to be held **June 19-22, 2000** at the Westin Hotel in Long Beach, California. Other participating professional societies include the **PSSEPM, SEG, SPWLA, AEG, DPA, DEG, EMD and AIPG**.

The technical focus of this first joint regional meeting between the **PSAAPG** and **SPE** is to demonstrate how petroleum technology is demanding further collaboration between earth scientists and engineers. The technical sessions will address exploration trends, recent E&P achievements, and the use of advanced technologies to further develop our bountiful oil and gas fields in the western United States. A new highlight is our plan to showcase our industry's efforts to form lasting partnerships with our communities and schools.

Please submit your Abstract by completing the abstract form on the **SPE Homepage** at [www.spe.org/events/2000wrm/callform.html](http://www.spe.org/events/2000wrm/callform.html). The abstract deadline is 10 December 1999. Authors will be notified in early January 2000.

Obtain more information on this event through the **PSAAPG Homepage** at [www.west.net/~psaapg](http://www.west.net/~psaapg) and the **SPE Los Angeles Basin Section Homepage** at [www.laspe.org](http://www.laspe.org). Professional societies wishing to join our event should contact Don Clarke at 562-570-3915 or at [doclar@ci.long-beach.ca.us](mailto:doclar@ci.long-beach.ca.us). We intend to give you a rewarding experience. Please join us!

Sincerely,

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### Need Help Writing An Abstract??

If you're the type who accomplishes technological feats but has a hard time writing about it, I will gladly help you write an abstract. With a few tips, you can have an abstract ready in no time. Ask for Lyman Handy at 714-525-6939 or email me at [lhandy@home.com](mailto:lhandy@home.com).

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## Human Influences on Climate Change Discussed at October 13th NCGS Meeting

The NCGS was quite fortunate to have renowned climate expert and 1998 McArthur Grant winner **Dr. Benjamin D. Santer** of Lawrence Livermore National Laboratory's Program for Climate Model Diagnosis and Intercomparison speak to its members on climate change. His presentation *Climate Change: Natural or Human-Induced?* Explored the various methods that climatological experts have used to evaluate climate change and assign causes to their observations.

Dr. Santer began by noting that in 1995 the Intergovernmental Panel on Climate Change (IPCC) concluded that scientific evidence "suggests a discernable human influence on global climate." He emphasized from the beginning that he was concerned with short-term climate change (essentially the last century) where scientific data is most abundant and accurate; and that he was not interested in taking a stand on whether the observed climatic changes were good or bad for the earth. His discussion basically covered three key topics: 1) What factors influence climate, how the climate has changed over the last century, and how it might change over the next century; 2) What are "fingerprint" studies and how are they used in climatological research; and 3) A discussion of recent attempts to resolve discrepancies between thermometer measurements of temperature change at the earth's surface and estimates of tropospheric temperature change by satellite monitors.

The natural factors that influence climate are the sun's energy output, most notably reflected in the 11 year sunspot activity cycle; changes in the atmospheric aerosol content by volcanic activity; and changes in the atmosphere-ocean climate coupling which is manifested in the now notorious El Nino / La Nina weather anomalies. The key man-made effects on the climate are changes in the "greenhouse" gases (CO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>O, and N<sub>2</sub>O); fossil fuel and biomass increases in the atmospheric aerosol content; and changes in the earth's albedo (reflectivity) due to human-induced changes in vegetation cover (deforestation). The natural influences have been well documented with studies of sunspot activity and the more recent focus on ocean-atmosphere coupling that was noted several hundred years ago by South American monks who originally gave the phenomenon its El Nino-La Nina moniker. Volcanic activity also has a well-recognized short-term influence on climate and has been documented in historic times by such major events as the late 19th Century Krakatoa eruption and more recently with the El Chichon (1985) and Mt. Pinatubo (1993) eruptions. Greenhouse gas effects have been monitored via Antarctic ice cores, which record a 160,000 year continuous dataset as air bubbles trapped in the glacial ice. These studies indicate an increase in the atmospheric carbon dioxide content over the last century from pre-industrial values of 270 to 280 ppm to the current level of 365 ppm. Scientific studies conducted since 1880 indicate: 1) the earth's surface temperature has increased 0.6°C (maximum error of ± 0.1°C); 2) the temperature in the upper atmosphere (measured in the stratosphere at elevations > 12 to 14 km.) via balloon and satellite readings has dropped since 1960 and is linked to a decrease in the ozone content; and 3) volcanic activity temporarily depletes the ozone layer and releases CO<sub>2</sub> into the atmosphere, but these effects are considered to be insignificant on a long-term global basis. Urbanization changes are also considered very minor in terms of effecting climate by altering the earth's surface reflectivity. Changes in the earth's ice mass over the last 100 years are likewise considered negligible.

The major tool used by climatologists to determine recent short-term variations in climate are computer models. To discern any human-induced signals, an anomaly must be noted and assigned to a cause. There is no geological model that takes into account continent configurations, tectonic, or volcanogenic effects on the climate for short time intervals. Hence, scientists must rely on computer modeling by numerical methods to sort through the acquired data. These models are the only way to screen out the climatic signals induced by human effects. To test the accuracy of the models, scientists are confined to using data compiled between 1978 and 1998, which includes voluminous satellite data and has the best global coverage. The "fingerprint" pattern studies by the various numerical models allow one to evaluate the short-term effects of different phenomena on a given climatic factor, such as mean surface temperature. This is obviously quite complex, as it involves latitudinal and seasonal effects that are best handled by computer modeling. The results of the different models are compared with the measured data to see if there is a correlation. By combining various influential factors such as CO<sub>2</sub> and aerosol increases into a given numerical model, scientists can test various hypotheses and rule out different factors as having produced certain observed climatic changes. The models themselves can be tested by performing a control run which omits, for instance, CO<sub>2</sub>, ozone, and aerosols from the calculation to see if the patterns match the acquired data. Then the other components can be inserted into the model to see if they have any effect on the pattern, and if the calculated pattern matches the observed data trends. Dr. Santer noted that the models can be used to separate signal trends from noise trends, and that short time intervals give higher signal-to-noise ratios.

Experts have concluded from exhaustive modeling that the known natural causes of climate variation cannot account for the observed trends in measured climatological factors. The lack of correlation between global patterns generated from surface temperature measurements and those acquired from lower troposphere satellite data are attributed to limited global coverage by surface data versus satellite monitoring, and to effects induced by surface features or wind speed on the temperature readings.

Dr. Santer concluded by emphasizing that climate is influenced by both natural and man-made effects, that studies have shown mankind has caused climatic change over the last century as best illustrated by the ~30% increase in global CO<sub>2</sub> levels, that the mean temperature is warmer now than in any time in the last 600 years, and that the earth's mean temperature has increased by about 0.5°C over the last century. The key sources of short-term climatic variation over the last 600 years are tree rings, ice cores, corals, and human historical accounts. The predicted climate change based on the observed trends and measurements is a global mean temperature increase of 1 to 3.5°C relative to 1990 by 2100, and a rise in sea level by 15 to 50 cm. relative to 1990 by 2100.

The NCGS sincerely thanks Dr. Santer for addressing its members at the October meeting on the controversial and political issue of man's role in global climate change. He gave an unbiased presentation of the IPCC's conclusions based on voluminous data acquired from a broad range of sources, levels of global coverage, and degrees of reliability. It will be interesting to see how these predictions and conclusions stand the test of time as remote sensing, data acquisition, and numerical processing techniques continue to improve.

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### **Members Study Neogene to Recent Tectonics in Central Diablo Range and Hunt Fossils on the Vallecitos-Coalinga Field Trip**

The October 2-3 two-day field trip to examine the geology and tectonics of the Central Diablo Range in the Vallecitos Syncline-Panoche Valley area took two dozen eager students and geologists on an exciting tour of some isolated field stops in the heart of Coast Range ranchland northwest of Coalinga. The first day of the trip was hosted by NCGS and Pacific Section AAPG Past President **Mel Erskine**, who has studied the area on-and-off for over two decades. His guidebook for the trip, *Analysis of Neogene to Recent Tectonics of the Central Diablo Range*, is an excellent introduction to the geology and tectonics of the Central Diablo Range. He interprets this part of the Coast Range as a broad antiform of thrust fault origin which began at least as early as the early Tertiary, and continued to evolve intermittently along the same thrust plane to the present time. Mel's work is still in progress, and relies heavily on field work done by Tom Dibblee and Tor Nilsen in the Vallecitos area that was published in a 1981 Pacific Section SEPM guidebook. Mel's guidebook is an introduction to his proposed tectonic model for the area, a balanced, blind-thrust model for fault-bend folding based on John Suppe's 1983 paper on this topic. Mel was also kind enough to compile a bibliography on thrusting that includes 15 references on thrust belts, thrust fault folding models, and balanced cross section techniques that he gave to the attendees.

The day began with a brief orientation by Mel prior to embarking on a several hour journey east on I-580 and south on I-5 to the Panoche Valley. He outlined the various stops we would visit that day and instructed everyone to pay attention to the important effects thrust faulting has on surface structural indicators and on the evolution of fold-thrust belts. As the caravan left San Ramon, Mel pointed out important geologic features associated with the Calaveras Fault in the San Ramon Valley, Quaternary to recent thrust-related features along the northern perimeter of the Livermore Valley, and the Greenville Fault where it crosses I-580 east of Livermore. Once in the San Joaquin Valley, Mel pointed out the manganese nodule placer deposits at Hospital Creek and noted that outcrops of Ione Formation had been discovered further south in Crow Creek. The latter is a unique occurrence of this unit that crops out in the Sierra Foothills and is encountered at depth in the San Joaquin Valley sediments. A key time-line used to establish thrusting relationships in the Central Diablo Range / Panoche Valley area is the Corcoran Clay, an aquitard correlated with the ~700,000 year old Bishop Tuff eruption that is exposed in the range, and is an important unit in the Central Valley that influences groundwater behavior. Outcrops in Orestimba Creek just a few miles south expose Kreyenhagen sediments cut by sedimentary dikes from the Domengine Formation that attest to high fluid pressures in the subsurface that many think helped facilitate thrusting.

The first stop was at the top of the dam at Little Panoche Creek which forms Little Panoche Reservoir. Looking southward the group could see the Tulare Formation (correlated with the Plio-Pleistocene Livermore

Gravels) exposed between flat-lying lakebeds in the Panoche Hills, a full 2,600 feet above the Corcoran Clay member of the Tulare Formation in the San Joaquin Valley to the east. The geometry of the thrusting as the Diablo Range was pushed in a N20°E direction over a distance of 8 miles from the Tesla-Ortogonalita Fault (Coast Range thrust) to its present leading edge at the range front overlooking the Central Valley allows one to calculate the dip of the eastern ramp of the blind thrust detachment surface. It is about 3.5° in a direction perpendicular to the range front. Assuming an age of 730,000 years for the Corcoran Clay, this segment of the Diablo Range has moved northeastward at a rate of about 1.8 cm. per year since the eruption of the Bishop Tuff. Mel also noted that the oblique transpressional strike-slip movement between the Pacific and North American Plates along the San Andreas Fault system provided the force that created the classic thrust belts in Wyoming and Alberta. The Tulare Formation is a marker in this area that was mapped by Bill Lettis of Lettis & Associates for his thesis. In the Suppe fault-bend folding model as applied to this area, the only folding is over the ramp section, and the listric faults are in the free face moving toward the San Joaquin Valley. The detachment surface here is at the base of the Late Cretaceous/Paleocene Moreno Formation. The tectonic style in thrust belts is controlled by stratigraphy and the distance to the free face of the thrust. Balanced cross sections are crucial to reconstructing the geometry of thrust belts, and the down-structure method of viewing geological maps is a technique that is quite useful for interpreting plunging thrusts in regions with complex tectonic histories. Ron Crane has used this method to interpret features in the Northern Diablo Range. At Little Panoche Creek, the group could look down the Panoche Syncline with the south limb dipping 5°N and the north limb dipping 2 to 3°S.

Mel took this opportunity to discuss the deeper structure of the Vallecitos syncline-New Idria anticline and its relationship to strong earthquake events recorded in the Coalinga area in 1983. The latter were an apparent M 5.5 foreshock on October 25, 1982 and the subsequent M 6.7 May 2, 1983 event that caused significant damage to buildings in Coalinga. The latter drew attention to the fact that major seismic activity can occur along blind thrust faults associated with compressional tectonic regimes. The two event epicenters plot at depths of 10 and 11 km., and suggest the location of basal ramp-run of the thrust system with an approximate 30° dip under this imbricate syncline-anticline pair to the southwest. The cluster of aftershock events recorded at shallower depths can be interpreted as minor adjustments in the upper plate of the thrust system to stresses associated with the bending of that plate under renewed thrusting activity. The group then took a short stop to view what is thought to be the Corcoran Clay lake bed (tuff) deposit in a cliff face to the south in part of the listric slump of the anticline before continuing to the next stop south of Mercy Hot Springs. The caravan climbed a steep road to a flat hilltop exposure of the Tulare Formation at 2000 feet on the south side of Panoche Valley. Here the Great Valley sequence sediments dip 55° east and are unconformably overlain by the relatively flat-lying Tulare deposits.

The third stop was in the Tesla-Ortogonalita fault zone at the entrance to Panoche Valley. This ½ mile-wide zone contains roadcut exposures of sheared serpentine, and high pressure-low temperature metamorphic assemblages including garnet-bearing glaucophane schist. The group descended into the Panoche Valley in the center of ranching country and stopped at the Panoche Inn to have lunch. This small establishment is the only bar in the area and is the social center for inhabitants of this sparsely populated rural area. After lunch Mel continued to lecture on the regional geology of the Diablo Range and emphasized that the fundamental structural element that controls the tectonic style in this region has not changed since the Paleocene.

Saturday afternoon was devoted to a series of stops along Griswold Canyon east and south of the Panoche Inn. The canyon cuts across the Cerro Bonito antiform from the Vallecitos syncline to the south. The group stopped briefly at the entrance to Griswold Canyon near the site of a mercury mine and smelter to discuss the local geology. Many streams in the area post-date the post-Miocene uplift of the antiform. The regional thrusting in the Diablo Range can be traced as far north as the Hetch Hetchy tunnel near Del Valle reservoir south of Livermore. Various structural features indicate the main thrusting in the Diablo Range began in the latest Cretaceous and unconformities indicate periodic reactivation in the mid-Eocene (Domegine Formation), late Eocene (Stockton Arch), late Oligocene, early Miocene (Temblor Formation), Miocene, and Pliocene (Tulare Formation). The main thrusting is north to northeast oblique to the Great Valley and Sierra Nevada Range, and may be an expression of force vectors associated with the bend in the San Andreas Fault or to the load of the thrust sheet. The following stop allowed the group to examine the concretion-bearing turbidites of the Great Valley sequence, a succession of sediments up to 25,000 feet thick that has been attenuated by faulting to ~4,000 feet thick. The final stop was at an outcrop of Domengine (Cantua member of the Paleocene-early Eocene Lodo Formation?). Here the group put **Professor Ray Sullivan** of San Francisco State on the spot and asked for his interpretation of the sedimentary sequence, which had originally been described as a deltaic sequence. Ray

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proceeded to walk along the outcrop and describe a textbook estuarine sedimentary progression, finding all of the required sedimentary sequences including fining upward sedimentary layers terminated in bioturbated brackish water mudstones. This parasequence repeats itself through the formation, which ultimately gives way to the deep water black shales of the transgressive Kreyenhagen Shale. Ray pointed out that the Domengine is a good reservoir rock because of its porous estuarine sands capped by relatively impermeable muds.

The group returned to the Panoche Inn, where most departed for home, but 10 adventurous souls stayed for a tasty barbecued chicken dinner prepared by the proprietor. Afterwards the campers stargazed and listened to a medley of songs accompanied on guitar by their host. After a good night's rest, the fossil hunters had breakfast and headed down the steep grade of Jackass Canyon to the Central Valley, and south on I-5 to Coalinga. **Bill Howell** led the group to a series of low hills along the range front north of Coalinga and among small pumping oil rigs to the fossiliferous outcrops of the fossiliferous Miocene Santa Margarita Formation. After what septuagenarian **Sherb Brown** described as a "senior moment," Bill momentarily lost his bearing in the complex terrain, but recovered to find the outcrop and begin a 2-hour fossil hunt. The most common prizes were large oyster shells and barnacle clusters, but some careful hunters, like **Al Hayes** managed to unearth intact pecten (clam) and scallop shells. The caravan stopped briefly at the well-maintained **R.C. Baker Memorial Museum** in Coalinga, then headed back up I-5 to the Bay Area.

This two-day trip completed the series of four excursions through the Northern and Central Diablo Range hosted by Ron Crane, Sandy Figuers, and Mel Erskine. Our thanks to **Mel** for taking time from his busy schedule to lead the trip, and for preparing an excellent guide with references for those interested in pursuing literature on the theory of thrust belt formation. **Bill Howell** did his usual superb job of shouldering the responsibility for arranging food, transportation, camping facilities, and handling the trip registration. Thanks also to **Sandy Figuers** for driving one of the vans on the first day, and providing his insightful commentary on Coast Range geology and structure.

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## CCGO RALLIES SUPPORT FOR GOOD BUILDING CODES

Geologists are solidly involved in the building code development process again, to the amazement of other high-profile professions and with the congratulations of numerous code officials. In mid-September, the California Council of Geoscience Organizations was joined in testifying at the 2000 International Building Code Final Action Hearings in St. Louis by representatives of the Association of Engineering Geologists and the American Institute of Professional Geologists.

We narrowly defeated a proposal by the National Council of Architectural Registration Boards to change 38 code sections to permit only architects or professional engineers to do the work of all registered design professionals, including geologists. The architects' comprehensive proposal was supported by building officials from cities that included Los Angeles, Pasadena, and Fremont, California, who argued that to protect public safety, buildings must be designed only by architects or engineers.

CCGO testified that a building designed by an architect or an engineer is only as stable as the site it sits on, only as good as the underlying geology. We emphasized that the proposed changes would prohibit geologists from carrying out their role in protecting public safety.

In the year since CCGO became involved in the code development process by submitting four proposed changes to the 2000 IBC, we have had slope stability added as a required consideration in building site investigations; built alliances with building officials, structural engineers, and interior design professionals; obtained admissions from architects' groups that they have no business performing geologic work; drawn two international geologic organizations back into the code development process; and reserved geologic work for geologists. Following CCGO's lead, geoscientists now have an opportunity to reverse some of the recent deletions of geologic requirements from the code and to benefit from our newly acquired stature as members of the code development community.

For further information, contact CCGO Code Development Committee Chair Betsy Mathieson: **Bmathieson@post.harvard.edu**, or CCGO President David Ebersold: **David.B.Ebersold@mw.com** or (626) 568-6943.

## U.S. Geological Survey World Wide Web Information

The U.S. Geological Survey (USGS) invites you to explore an earth science virtual library of digital information, publications, and data. The USGS Internet World Wide Web sites offer an array of information that reflects scientific research and monitoring programs conducted in the areas of natural hazards, environmental resources, and cartography. This list provides gateways to access a cross section of the digital information on the USGS World Wide Web sites.

### World Wide Web Sites

#### Primary Home Pages

U.S. Geological Survey  
<http://www.usgs.gov/>

Biological Resources Division  
<http://biology.usgs.gov/>

Geologic Information  
<http://geology.usgs.gov/>

National Mapping Information  
<http://mapping.usgs.gov/>

Water Resources Information  
<http://water.usgs.gov/>

#### Data and Information Sites

Amphibians  
<http://www.frogweb.gov/>

Biological Cooperative Research Units  
<http://biology.usgs.gov/coop/>

Biological Resources National Programs  
[http://biology.usgs.gov/pub\\_aff/natprog.html](http://biology.usgs.gov/pub_aff/natprog.html)

Biological Science and Technology Centers  
<http://biology.usgs.gov/pub-aff/centers.html>

Breeding Bird Survey  
<http://www.mbrpwr.usgs.gov/bbs/bbs.html>

Center for Integration of Natural Disaster Information  
<http://cindi.usgs.gov/events/>

Coastal and Marine Geology  
<http://marine.usgs.gov/>

Current Streamflow Conditions  
<http://water.usgs.gov/public/realtime.html>

Data Available from EROS Data Center  
<http://edcwww.cr.usgs.gov/doc/edchome/datasets/edcdata.html>

Declassified Intelligence Satellite Photographs  
<http://edcwww.cr.usgs.gov/glis/hyper/guide/dispatch/>

Earthquake Information  
<http://quake.wr.usgs.gov/>  
<http://geology.usgs.gov/quake.html>  
<http://geohazards.cr.usgs.gov/earthquake.html>  
<http://geohazards.cr.usgs.gov/eq/>

Earth Science Information Center (ESIC)  
<http://mapping.usgs.gov/esic/>

Energy Resources  
<http://energy.usgs.gov/>

EROS Data Center Home Page  
<http://edcwww.cr.usgs.gov/>

Geographic Names Information System (GNIS)  
<http://mapping.usgs.gov/www/gnis/>

Global Change  
<http://geochange.er.usgs.gov/>

Global Land Information System (GLIS)  
<http://edcwww.cr.usgs.gov/glis/glis.html>

Historical Streamflow  
<http://waterdata.usgs.gov/nwis-w/US/>

Locating Publications and Data Products  
<http://www.usgs.gov/pubprod/index.html#online>

Mineral Resources  
<http://minerals.er.usgs.gov/>

National Geologic Mapping  
<http://ncgmp.usgs.gov/>

National Geospatial Data Clearinghouse, USGS Node  
<http://nsdi.usgs.gov/>

National Water Conditions  
<http://water.usgs.gov/nwc/>

National Water-Quality Assessment Program  
[http://www.rvares.er.usgs.gov/nawqa/nawqa\\_home.html](http://www.rvares.er.usgs.gov/nawqa/nawqa_home.html)

North American Reporting Center for Amphibian Malformations  
<http://www.npwr.usgs.gov/narcam/>

Real-Time Streamflow  
<http://water.usgs.gov/public/realtime.html>

US GeoData—File Transfer Protocol (FTP) Access  
<http://edcwww.cr.usgs.gov/doc/edchome/ndcdb/ndcdb.html>

USGS by Theme—Environment, Resources, Hazards, Information Management  
<http://www.usgs.gov/themes/>

million years ago. It was eventually buried by runoff from the Sierra Nevada Mountains. Several other craters found in North America are of similar age, according to NASA, and may suggest that the earth passed through a major meteor stream during Miocene time.

**Richard Blake** joined Lawrence Livermore National Laboratory in 1992 as a hydrogeologist and has a B.S. and M.S. in geology from California State University at Los Angeles. He is a California Registered Geologist and works as a hydrogeologist in the Environmental Restoration Division the Laboratory. Prior to joining the Lab, Blake worked as a petroleum geologist for twelve years in the California oil and gas industry, and continues to consult on California exploration projects.

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