NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

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MEETING ANNOUNCEMENT

DATE: **September 28, 2011**

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

TIME: **6:30 p.m. social; 7:00 p.m. talk (no dinner) Cost: $5 per regular member; $1 per student or K – 12 teachers**

SPEAKER: **Dr. William E. Motzer**
Todd Engineers, Inc.

California's Gold:
History, Geology, and Geochemistry

THE "MINES"

Placer and Underground Mining: In January 1848, James Marshall was camped with a work crew on the American River at Coloma near present-day Auburn, building a saw mill for John Sutter. On January 24, Marshall discovered several gold nuggets in the river's gravel; the subsequent announcement published in San Francisco's one-page newspaper *The Californian*, was not widely believed but it resulted in one of the largest historical human migrations with perhaps 500,000 people world-wide finally descending on California with the desire to reap instant wealth. Placer gold was subsequently discovered in the Feather River and Trinity River drainages. By August 1848, news had reached the east coast and by December, President Polk announced the discovery in congress setting off the Great California 1849 Gold Rush with thousands of itinerant miners descending on the rich surface and near surface placer deposits of the western Sierra Nevada. These *Forty-Niners* also followed the placers back to their quartz vein origins or to *The Mother Lode* (ML) where underground mining began at the Mariposa mine in Mariposa County. In 1850, California became a state with the border moved eastward to include the entire Sierra Nevada. Also in that year, gold-bearing quartz veins were discovered at Gold Hill in Grass Valley, leading to development of large underground mines such as the Empire and Idaho-Maryland mines. In 1853, the first extensive underground mining of buried alluvial river channels (drift mining) commenced at Foresthill in Placer County.

Hydraulic Mining began in 1852 at American Hill just north of Nevada City and at Yankee Jims in Placer County. It rapidly replaced the solitary prospector's panning methods and by 1864 was conducted on a large-scale industrial process. Miners dammed and diverted streams in a vast system of canals (called *ditches*) so that they could wash down auriferous gravel hillsides with high-pressure jets of water (known as *water cannons* or *monitors*). Washed gravels were processed through long wooden sluice boxes to extract placer gold. Gravels and fine sediment—called *slickens*—were then discharged back into the streams, subsequently washing down into the lower Sacramento Valley. From about 1850 to 1884, an estimated 250 million cubic yards (Myds^3) of gravel produced 12 million ounces (Moz) of gold. The large influx of hydraulic mine tailings (up to 685 Mft^3 of debris) were deposited in the lower Yuba River, raising the river bed as much as 45 feet in places. In 1884, hydraulic mining was prohibited by the now famous Sawyer Decision. *…Continued on page 2…*

NCGS 2010 – 2011 Calendar

Wednesday September 28, 2011
Dr. William E. Motzer, Todd Engineers, Inc;
California's Gold: History, Geology, and Geochemistry
7:00 pm at Orinda Masonic Lodge

Saturday, October 15, 2011
A Teacher's Workshop - Earth Science Week Field Trip for K-12 Teachers
A Geological Walk in Downtown San Francisco

October 26, 2011
Dr. Richard Allen, University of California Berkeley,
Seismic Hazard Mitigation and Earthquake Early Warning System (Topic)
7:00 pm at Orinda Masonic Lodge

November 16, 2011
Michelle Newcomer, SFSU, Internship projects at NASA Ames (Topic)
7:00 pm at Orinda Masonic Lodge

December 2011 – Our Usual Holiday Break

January 25, 2012
TBA
7:00 pm at Orinda Masonic Lodge

Upcoming NCGS Events

Saturday, October 15, 2011
A Teacher's Workshop - Earth Science Week Field Trip for K-12 Teachers
A Geological Walk in Downtown San Francisco
(Do you know a teacher who might be interested? Let them know!)

Do you have a place you've wanted to visit for the geology? Let us know. We're definitely interested in ideas. For those suggestions, or for questions regarding, field trips, please contact Tridib Guha at: **Tridibguha@sbcglobal.net**

Peninsula Geologic Society
Upcoming meetings

For an updated list of meetings, abstracts, and field trips go to http://www.diggles.com/pgs/. The PGS has also posted guidebooks for downloading, as well as photographs from recent field trips at this web address. Please check the website for current details.

Bay Area Science

(http://www.bayareascience.org/)
This website provides a free weekly emailed newsletter consisting of an extensive listing of local science based activities (evening lectures, classes, field trips, hikes, and etc).

Association of Engineering Geologists San Francisco Section
Upcoming Events

Meeting locations rotate between San Francisco, the East Bay, and the South Bay. Please check the website for current details.

To download meeting details and registration form go to: http://www.aegsf.org/.

USGS Evening Public Lecture Series

The USGS Evening Public Lecture Series events are free and are intended for a general public audience that may not be familiar with the science being discussed. Monthly lectures are usually scheduled for the last Thursday evening of each month during most of the year but are occasionally presented on the preceding Thursday evening to accommodate the speakers. For more information on the lectures, including a map of the lecture location (Building 3, 2nd floor; Conference Room A) go to: http://online.wr.usgs.gov/calendar/

- September 22, 2011; Tracking the Nation's Groundwater Reserves – Issues facing current and future water supplies; William Alley

Undergraduate Scholarship Grant Suspension

At the NCGS Board meeting of May 14, 2011, NCGS elected to temporarily suspend the undergraduate scholarships for the coming year, principally due to the limited number of proposals that have been received over the recent past. xxx

Presentation Abstract (continued)
California's Gold: History, Geology, and Geochemistry

Dredging in California river alluvium began in 1850, when a small boat fitted as a dredge attempted gravel mining on the Yuba River above Marysville. In 1893, the California Debris Commission also began dredging the Yuba River near Marysville to mitigate environmental damage caused by earlier hydraulic mining. Gold production also commenced again increasing with the construction of larger dredges. In 1898, the first successful gold dredge was introduced on the lower Feather River near Oroville. In 1904, the Yuba Consolidated Gold Fields Company was founded becoming a large, profitable placer dredging operation on the Yuba River. By 1911 California had 62 operating bucket-elevator dredges.

Of those, only a single dredge (Yuba No. 17) currently mines gold.

Open Pit (OP) mining for disseminated gold (DG) actually began in 1902 at Randsberg with development of the Yellow Aster OP and more recently the Baltic OP (1983 to 2003), which produced ~1.0 Moz) gold (Au). Homestake's McLaughlin mine (1985 to 1996) in Napa-Sonoma Counties, a mercury-gold "fossil" hot springs deposit produced 3.3 Moz Au. From 1983 to 1994, the Harvard OP at Jamestown (near Sonora), produced 0.660 Moz Au from the ML veins and gold disseminated into surrounding wall rock. Other OP gold mines occur in the Basin Ranges and western Sierra Nevada.

THE "GOLD"

ML Gold Belt (GB) Geology

The ML GB has a very complex geology: rocks are composed of both island arc (mafic, intermediate, and felsic rocks mostly of pyroclastic origin), oceanic (mafic, tholeiitic volcanic, and associated sediments), and intrusive accreted terrains from about mid-Devonian to Cretaceous time (~400 to100 million years ago or Ma). These now form the Western Metamorphic Belt (WMB) on the west side of the Sierra Nevada batholith, extending northwest for ~200 miles through the foothills of the central and northern Sierra. The southern WMB, near Mariposa is ~30 miles wide, widening northward to ~60 miles in the northern Sierra. The WMB is divided into three major northwest trending units: (1) The Shoo Fly Complex on the eastern side, (2) the Calaveras Complex (CC) in the center, and (3) the Foothills Terrain on the west. Each is bounded and separated by large fault systems many of which extend the entire WMB length. This series of faults are also comprises the Foothills fault system (FFS) and most of the ML gold deposits occur here. One of these, the Melones fault zone (MFZ), dips steeply eastward, bisecting CC rocks; it is identified by intensely sheared rocks, quartz veins, and serpentine lenses. The MFZ has been mineralized with gold and copper, zinc, and lead sulfides. Large ML vein gold deposits closely follow the MFZ from Placerville to Mariposa. In the southern and central parts of the WMB, the MFZ splays northward; however, there is some uncertainty concerning its northern Sierra counterpart. Most of the gold/sulfide mineralization postdates WMB and Sierra Nevada plutonic rocks with estimated emplacement between 115 and 120 Ma.

Placer Geology

Tertiary alluvial placer deposits generally form in moderate to high energy depositional environments where gradients tend to flatten and river velocities decrease, particularly at the inside of river meanders, below rapids and falls, beneath boulders, and in vegetation mats. These deposits are therefore composed of silt and sand to cobble and boulder sized gravel and conglomerate containing white quartz clasts with sand and sandstone generally of secondary importance.

Placer deposits may contain either gold, with minor platinum group metals (PGM) or PGM with minor gold in grains and nuggets. Gold occurs with very little silver and PGM occurs as platinum-iron and/or osmium-iridium alloys. Gold forms flattened flakes with rounded edges and as "flour" gold which consist of extremely fine-grained flakes. Nuggets are generally irregular and very rarely equi-dimensional in form (see descriptions of geochemical formation below).

Gold Geochemistry

Primary or hypogene gold is that which has been deposited and/or precipitated from high-temperature hydrothermal fluids originating deep in the crust commonly associated with intruding magma or shallower meteoric water. Native or free gold commonly occurs in crystalline form. Most primary gold ores are gold-silver (Au-Ag) alloys, generally with Au/Ag ratios greater than (>) 1. Primary gold typically contains from 5 to 20% silver, but in some deposits, it may be almost pure; in other cases, silver may exceed 50%.

Secondary or supergene gold occurs when primary gold is mobilized or dissolved as Au-complexes from several organic and inorganic ligands that are then reprecipitated in surface or weathering environments. It also may form from reduction by bacteria of Au-chlorides in saline Au-rich groundwater where visible gold plates are precipitated at the water table as nanoparticles (100 to 300 µm), ultimately producing hexagonal and triangular gold crystals as small as 50 nm. Most fine or placer gold is secondary, which is nearly pure with high fineness, generally having less than (<) 1% Ag. Secondary gold may occur in soil, deep regolith, stream sediments, and placers.

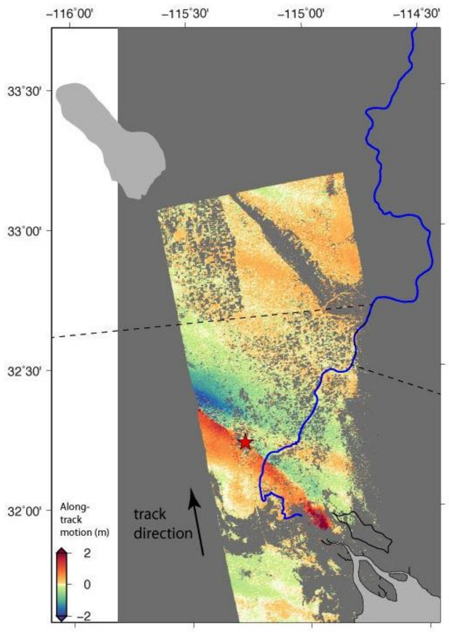
Placer gold may also form as nuggets generally having Au–Ag alloys chemically similar to that of primary gold; commonly there is Ag depletion on crystal boundaries where exterior surfaces are exposed to weathering. Physical crystallography analysis of nuggets also indicates a hypogene origin because many nuggets have internal even-textured, polycrystalline fabrics, with crystals often exhibiting both coherent and incoherent twinning. Such textures have also been confirmed in Au-Ag metallographic studies characteristic of thermal annealing at temperatures >250°C. These similarities show a definite hypogene origin. Therefore, the relative abundance of nuggets in surficial environments is due to physical concentration by weathering of primary ores and subsequent fluvial transport. *…Continued on the back…*

Unusual Fault Pattern Surfaces in Earthquake Study

ScienceDaily (Aug. 12, 2011) — Like scars that remain on the skin long after a wound has healed, earthquake fault lines can be traced on Earth's surface long after their initial rupture. Typically, this line of intersection is more complicated at the surface than at depth. But a new study of the April 4, 2010, El Mayor-Cucapah earthquake in Baja California, Mexico, reveals a reversal of this trend. Superficially, the fault involved in the magnitude 7.2 earthquake appeared to be straight, but at depth, it's warped and complicated.

The study, which was led by researchers at the California Institute of Technology with NASA Jet Propulsion Laboratory geophysicist Eric Fielding serving as a coauthor, is available online in the journal *Nature Geoscience*.

In a standard model, transform plate boundary structures -- where two plates slide past one another -- tend to be vertically oriented, which allows for lateral side-by-side shear fault motion. However, as the study found, the 75 mile (120 kilometer) long El Mayor-Cucapah rupture involved angled, non-vertical faults and the event began on a connecting extension fault between the two segments.



Horizontal motion measured from radar images reveals the faults that moved in the magnitude 7.2 earthquake in Baja California, Mexico. (Credit: JAXA/METI/NASA/JPL-Caltech)

The new analysis indicates the responsible fault is more segmented deep down than its straight surface trace suggests. This means the evolution and extent of this earthquake's rupture could not have been accurately anticipated from the surface geology alone, says the study's lead author Shengji Wei. Anticipating the characteristics of earthquakes that would likely happen on young fault systems (like the event in the study) is a challenge, since the geologic structures involved in the new fault systems are not clear enough.

Jean-Philippe Avouac, director of Caltech's Tectonics Observatory and principal investigator on the study, says the data can be used to illustrate the process by which the plate boundary -- which separates the Pacific Plate from North America -- evolves and starts connecting the Gulf of California to the Elsinore fault in Southern California.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by NASA/Jet Propulsion Laboratory. The original article was written by Katie Neith.

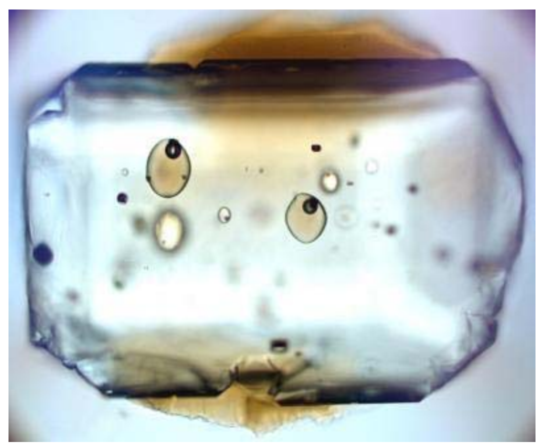
Journal Reference:

Shengji Wei, Eric Fielding, Sebastien Leprince, Anthony Sladen, Jean-Philippe Avouac, Don Helmberger, Egill Hauksson, Risheng Chu, Mark Simons, Kenneth Hudnut, Thomas Herring, Richard Briggs. **Superficial simplicity of the 2010 El Mayor–Cucapah earthquake of Baja California in Mexico**. *Nature Geoscience*, 2011

Deep Recycling in Earth Faster Than Thought

ScienceDaily (Aug. 10, 2011) — The recycling of Earth's crust in volcanoes happens much faster than scientists have previously assumed. Rock of the oceanic crust, which sinks deep into the earth due to the movement of tectonic plates, reemerges through volcanic eruptions after around 500 million years. Researchers from the Max Planck Institute for Chemistry in Mainz obtained this result using volcanic rock samples. Previously, geologists thought this process would take about two billion years.

Virtually all of the ocean islands are volcanoes. Several of them, such as Hawaii, originate from the lowest part of the mantle. This geological process is similar to the movement of coloured liquids in a lava lamp: hot rock rises in cylindrical columns, the so-called mantle plumes, from a depth of nearly 3000 kilometres. Near the surface, it melts, because the pressure is reduced, and forms volcanoes. The plume originates from former ocean crust which early in Earth's history sank to the bottom of the mantle. Previously, scientists had assumed that this recycling took about two billion years.



These are olivine crystals from Mauna Loa volcano, Hawaii, with a width of less than 1 mm. The brown ovals are solidified, glassy inclusions trapped as droplets of melt by the growing olivine crystal. They contain strontium isotope ratios which are inherited from 500-million-year-old seawater. (Credit: Sobolev, Max Planck Institute for Chemistry.)

The chemical analysis of tiny glassy inclusions in olivine crystals from basaltic lava on Mauna Loa volcano in Hawaii has now surprised geologists: the entire recycling process requires at most half a billion years, four times faster than previously thought.

The microscopically small inclusions in the volcanic rock contain trace elements originally dissolved in seawater, and this allows the recycling process to be dated. Before the old ocean crust sinks into the mantle, it soaks up seawater, which leaves tell-tale trace elements in the rock. The age is revealed by the isotopic ratio of strontium which changes with time. Strontium is a chemical element, which occurs in trace amounts in sea water. The isotopes of chemical elements have the same number of protons but different numbers of neutrons. Mainz scientists developed a special laser mass spectrometry method which allowed the detection of isotopes of strontium in extremely small quantities.

To their surprise, the Max Planck researchers found residues of sea water with an unexpected strontium isotope ratio in the samples, which suggested an age of less than 500 million years for the inclusions. Therefore the rock material forming the Hawaiian basalts must be younger.

"Apparently strontium from sea water has reached deep in the Earth's mantle, and reemerged after only half a billion years, in Hawaiian volcano lavas," says Klaus Peter Jochum, co-author of the publication. "This discovery was a huge surprise for us."

Another surprise for the scientists was the tremendous variation of strontium isotope ratios found in the melt inclusions in olivine from the single lava sample. "This variation is much larger than the known range for all Hawaiian lavas," says Alexander Sobolev. "This finding suggests that the mantle is far more chemically heterogeneous on a small spatial scale than we thought before." This heterogeneity is preserved only by melt inclusions but is completely obliterated in the lavas because of their complete mixing.

Sobolev, Jochum and their colleagues expect to obtain similar results for other volcanoes and therefore be able to determine the recycling age the ocean crust more precisely.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Max-Planck-Gesellschaft.

Journal Reference:

Alexander V. Sobolev, Albrecht W. Hofmann, Klaus Peter Jochum, Dmitry V. Kuzmin, Brigitte Stoll. **A young source for the Hawaiian plume**. *Nature*, 2011

Yeast's Epic Journey 500 Years Ago Gave Rise to Lager Beer

(Ed. Note: Granted this is not geology, but it's near and dear to many hearts!)

ScienceDaily (Aug. 22, 2011) — In the 15th century, when Europeans first began moving people and goods across the Atlantic, a microscopic stowaway somehow made its way to the caves and monasteries of Bavaria.

The stowaway, a yeast that may have been transported from a distant shore on a piece of wood or in the stomach of a fruit fly, was destined for great things. In the dank caves and monastery cellars where 15th century brewmeisters stored their product, the newly arrived yeast fused with a distant relative, the domesticated yeast used for millennia to make leavened bread and ferment wine and ale. The resulting hybrid -- representing a marriage of species as evolutionarily separated as humans and chickens -- would give us lager, the clear, cold-fermented beer first brewed by 15th century Bavarians and that today is among the most popular -- if not the most popular -- alcoholic beverage in the world.

And while scientists and brewers have long known that the yeast that gives beer the capacity to ferment at cold temperatures was a hybrid, only one player was known: Saccharomyces cerevisiae, the yeast used to make leavened bread and ferment wine and ale. Its partner, which conferred on beer the ability to ferment in the cold, remained a puzzle, as scientists were unable to find it among the 1,000 or so species of yeast known to science.

Orange-colored galls, such as these pictured in 2010, from the beech tree forests of Patagonia have been found to harbor the yeast that makes lager beer possible. Five hundred years ago, in the age of sail and when the trans-Atlantic trade was just beginning, the yeast somehow made its way from Patagonia to the caves and monastery cellars of Bavaria where the first lager beers were fermented. University of Wisconsin–Madison Genetics Professor Chris Todd Hittinger and colleagues from Portugal, Argentina and the University of Colorado describe the lager yeast, whose origin was previously unknown. (Credit: Photo by Diego Libkind, Institute for Biodiversity and Environment Research, Bariloche, Argentina)

Now, an international team of researchers believes it has identified the wild yeast that, in the age of sail, apparently traveled more than 7,000 miles to those Bavarian caves to make a fortuitous microbial match that today underpins the $250 billion a year lager beer industry.

Writing in the *Proceedings of the National Academy of Sciences*, researchers from Portugal, Argentina and the United States describe the discovery of a wild yeast in the beech forests of Patagonia, the alpine region at the tip of South America, that apparently solves the age-old mystery of the origin of the yeast that made cold-temperature fermentation and lager beer possible.

"People have been hunting for this thing for decades," explains Chris Todd Hittinger, a University of Wisconsin-Madison genetics professor and a co-author of the new study. "And now we've found it. It is clearly the missing species. The only thing we can't say is if it also exists elsewhere (in the wild) and hasn't been found."

The newfound yeast, dubbed Saccharomyces eubayanus, was discovered as part of an exhaustive global search, led by the New University of Lisbon's José Paulo Sampaio and Paula Gonçalves. Aimed squarely at resolving the lager yeast mystery, the Portuguese team sorted through European yeast collections, combed the scientific literature and gathered new yeasts from European environments. Their efforts yielded no candidate species of European origin.

Expanding the search to other parts of the world, however, finally paid dividends when collaborator Diego Libkind of the Institute for Biodiversity and Environment Research (CONICET) in Bariloche, Argentina, found in galls that infect beech trees a candidate species whose genetic material seemed to be a close match to the missing half of the lager yeast.

"Beech galls are very rich in simple sugars. It's a sugar rich habitat that yeast seem to love," notes Hittinger.

The yeast is so active in the galls, according to Libkind, that they spontaneously ferment. "When overmature, they fall all together to the (forest) floor where they often form a thick carpet that has an intense ethanol odor, most probably due to the hard work of our new Saccharomyces eubayanus."

The new yeast was hustled off to the University of Colorado School of Medicine, where a team that included Hittinger, Jim Dover and Mark Johnston sequenced its genome. "It proved to be distinct from every known wild species of yeast, but was 99.5 percent identical to the non-ale yeast portion of the lager genome," says Hittinger, now an assistant professor of genetics at UW-Madison.

The Colorado team also identified genetic mutations in the lager yeast hybrid distinctive from the genome of the wild lager yeast. Those changes -- taking place in a brewing environment where evolution can be amped up by the abundance of yeast -- accumulated since those first immigrant yeasts melded with their ale cousins 500 years ago and have refined the lager yeast's ability to metabolize sugar and malt and to produce sulfites, transforming an organism that evolved on beech trees into a lean, mean beer-making machine.

"Our discovery suggests that hybridization instantaneously formed an imperfect 'proto-lager' yeast that was more cold-tolerant than ale yeast and ideal for the cool Bavarian lagering process," Hittinger avers. "After adding some new variation for brewers to exploit, its sugar metabolism probably became more like ale yeast and better at producing beer."

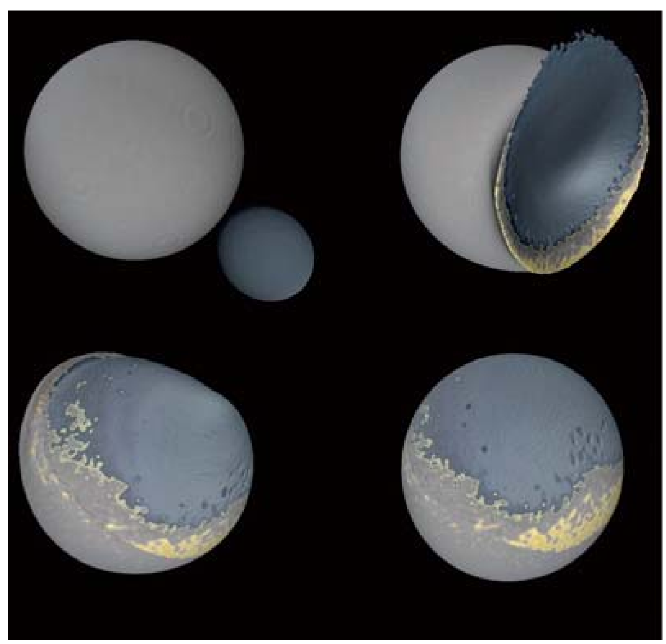
Story Source: The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by University of Wisconsin-Madison.

Journal Reference:

Diego Libkind, Chris Todd Hittinger, Elisabete Valério, Carla Gonçalves, Jim Dover, Mark Johnston, Paula Gonçalves, José Paulo Sampaio. **Microbe domestication and the identification of the wild genetic stock of lager-brewing yeast**. *Proceedings of the National Academy of Sciences*, 2011

Big splat' may explain moon's mountainous far side

UC Santa Cruz News; August 03, 2011



Four snapshots from the computer simulation of a collision between the moon and a smaller companion moon show most of the companion moon is accreted as a pancake-shaped layer, forming a mountainous region on one side of the moon. Credit: M. Jutzi and E. Asphaug, Nature.

The mountainous region on the far side of the moon, known as the lunar farside highlands, may be the solid remains of a collision with a smaller companion moon, according to a new study by planetary scientists at the University of California, Santa Cruz.

The striking differences between the near and far sides of the moon have been a longstanding puzzle. The near side is relatively low and flat, while the topography of the far side is high and mountainous, with a much thicker crust. The new study, published in the August 4 issue of *Nature*, builds on the "giant impact" model for the origin of the moon, in which a Mars-sized object collided with Earth early in the history of the solar system and ejected debris that coalesced to form the moon. The study suggests that this giant impact also created another, smaller body, initially sharing an orbit with the moon, that eventually fell back onto the moon and coated one side with an extra layer of solid crust tens of kilometers thick.

"Our model works well with models of the moon-forming giant impact, which predict there should be massive debris left in orbit about the Earth, besides the moon itself. It agrees with what is known about the dynamical stability of such a system, the timing of the cooling of the moon, and the ages of lunar rocks," said Erik Asphaug, professor of Earth and planetary sciences at UC Santa Cruz.

Asphaug, who coauthored the paper with UCSC postdoctoral researcher Martin Jutzi, has previously done computer simulations of the moon-forming giant impact. He said companion moons are a common outcome of such simulations.

In the new study, he and Jutzi used computer simulations of an impact between the moon and a smaller companion (about one-thirtieth the mass of the moon) to study the dynamics of the collision and track the evolution and distribution of lunar material in its aftermath. In such a low-velocity collision, the impact does not form a crater and does not cause much melting. Instead, most of the colliding material is piled onto the impacted hemisphere as a thick new layer of solid crust, forming a mountainous region comparable in extent to the lunar farside highlands.

"Of course, impact modelers try to explain everything with collisions. In this case, it requires an odd collision: being slow, it does not form a crater, but splats material onto one side," Asphaug said. "It is something new to think about."

He and Jutzi hypothesize that the companion moon was initially trapped at one of the gravitationally stable "Trojan points" sharing the moon's orbit, and became destabilized after the moon's orbit had expanded far from Earth. "The collision could have happened anywhere on the moon," Jutzi said. "The final body is lopsided and would reorient so that one side faces Earth."

The model may also explain variations in the composition of the moon's crust, which is dominated on the near side by terrain comparatively rich in potassium, rare-earth elements, and phosphorus (KREEP). These elements, as well as uranium and thorium, are believed to have been concentrated in the magma ocean that remained as molten rock solidified under the moon's thickening crust. In the simulations, the collision squishes this KREEP-rich layer onto the opposite hemisphere, setting the stage for the geology now seen on the near side of the moon.

Other models have been proposed to explain the formation of the highlands, including one published last year in *Science* by Jutzi and Asphaug's colleagues at UC Santa Cruz, Ian Garrick-Bethell and Francis Nimmo. Their analysis suggested that tidal forces, rather than an impact, were responsible for shaping the thickness of the moon's crust.

"The fact that the near side of the moon looks so different to the far side has been a puzzle since the dawn of the space age, perhaps second only to the origin of the moon itself," said Nimmo, a professor of Earth and planetary sciences. "One of the elegant aspects of Erik's article is that it links these two puzzles together: perhaps the giant collision that formed the moon also spalled off some smaller bodies, one of which later fell back to the Moon to cause the dichotomy that we see today."

For now, he said, there is not enough data to say which of the alternative models offers the best explanation for the lunar dichotomy. "As further spacecraft data (and, hopefully, lunar samples) are obtained, which of these two hypotheses is more nearly correct will become clear," Nimmo said.

The new study was supported by NASA's Planetary Geology and Geophysics Program. Simulations were run on the NSF-sponsored UC Santa Cruz astrophysics supercomputer *pleiades*.

NCGS Scholarships, K-12 Earth Science Teacher of the Year, & Geoscience Teaching Award Announcements

Please send the following announcements to folks you know who may have an interest in these NCGS programs!

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY and
AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS

2011-2012 K-12 EARTH SCIENCE TEACHER OF THE YEAR AWARD

$750 Northern California Geological Society
$500 Pacific Section AAPG
$5,000 National AAPG

Call for Nominations for 2011 - 2012 NCGS Competition

The Northern California Geological Society (NCGS) is seeking applications from candidates in Northern California for the 2011 - 2012 Earth Science Teacher of the Year Award. The $750 NCGS award is intended to recognize pre-college earth science programs already in place, and to encourage their organization in districts where they have not been fully developed. Nominations of qualified K-12 teacher candidates are solicited from teachers, school administrators, teacher outreach programs, and other interested parties. The NCGS award will be announced February 2012.

The NCGS awardee's application will be submitted to a regional competition sponsored by the American Association of Petroleum Geologists (AAPG) Pacific Section. The Pacific Section winner will receive a $500 award at the Pacific Section regional meeting in Long Beach, CA, April 2012, plus up to $250 toward meeting expenses. The regional winner's project will be submitted to AAPG headquarters for the national contest. The national award winner will receive an expense-paid trip to attend the AAPG meeting in Pittsburgh, PA, May, 2013.

At the national level, the AAPG Foundation presents an annual $5,000 award to a K-12 teacher for *Excellence in the Teaching of Natural Resources in the Earth Science.* The award recognizes balanced incorporation of natural resource extraction and environmental sustainability concepts in pre-college Earth science curricula. It includes $2,500 to the teacher's school for the winning teacher's use, and $2,500 for the teacher's personal use.

The deadline for application submittal by candidates for the $750 NCGS award is Monday, January 16, 2012.

Interested candidates or nominators can request Application Information and an Entrant Application Form, or submit an application, by contacting:

Paul Henshaw
Chair, K – 12 Geosciences Education Committee
Northern California Geological Society
6 Rachel Ranch Court
Clayton, CA 94517
(925) 673-8745
candphenshaw@comcast.net

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

2012 K-12 GEOSCIENCE TEACHING AWARD

$500

Call for Applications for 2011 - 2012 NCGS Competition

The Northern California Geological Society (NCGS) invites applications from candidates in the Northern California for 2011-2012 K-12 Geoscience Teaching Award. Applications may be submitted by any teacher regardless of experience. Entries will be judged in two categories: Grades K-8 and Grades 9-12

Applications should address teaching of units covering any of the earth or environmental sciences, including but not limited to mineralogy, petrology, economic geology, geomorphology, paleontology, hydrology, and planetary geology are invited from physical science, earth science, and geology teachers.

The deadline for application submittal by candidates for the $500 NCGS award is Monday, January 16, 2012. **The application process is simple (see Application Information and Application Form)**.

The winner will receive a $500 award at a Northern California Geological Society meeting in Orinda in late February 2012.

Interested candidates can request an *Application Information* and an *Entrant Application Form* or submit an application by contacting:

Paul Henshaw
Chair, K – 12 Geosciences Education Committee
Northern California Geological Society
6 Rachel Ranch Court
Clayton, CA 94517
(925) 673-8745
candphenshaw@comcast.net

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

2011-2012 RICHARD CHAMBERS MEMORIAL SCHOLARSHIPS

The NORTHERN CALIFORNIA GEOLOGICAL SOCIETY is pleased to announce the availability of their **Richard Chambers Memorial Scholarships** to help support graduate research in geology during the 2011-2012 academic years.

$ 1,000 Scholarship for Masters Students

$ 2,000 Scholarship for Doctoral students

Multiple Scholarships may be awarded at each academic level

These scholarships will be awarded competitively, based upon review of research proposals. Funds are intended to support field and laboratory components of research programs. Research should be scheduled for completion during the 2012 calendar year. Winners will be invited to speak or present a poster of their research at an NCGS meeting in Orinda, California.

Funding priority for these scholarships will be directed to research topics in general geology, geologic mapping, structural, economic, engineering and environmental geology, geophysics, stratigraphy, paleontology and paleoecology conducted in northern California and/or states immediately adjacent to northern California.

Application Procedure

Candidates may apply by forwarding a signed cover letter on your University's department letterhead requesting the award, accompanied by a brief (no more than 2 pages) research proposal. The letter must include the candidates contact information (departmental and home addresses, email addresses, and telephone numbers).

The bottom of the candidate's letter must bear this completed note:

Degree Program: ___________ Approved by: _________________ (print) __________________
Title: ___________ Telephone: ____________ email address ________________ Date: ________

With the signature and printed name, title, telephone and email of the department chairperson or thesis advisor. Please indicate which scholarship (Masters or PhD) you are applying for. **No other application is required**.

Please submit your letter and proposal by **U.S. MAIL postmarked** no later than **DECEMBER 16, 2011** to:

Phillip Garbutt, Chair
NCGS Scholarship Committee
6372 Boone Drive
Castro Valley, CA 94552-5077

Voice: (510) 581-9098
email: plgarbutt@comcast.net
NCGS website: http://www.ncgeolsoc.org
Issued: September 1, 2011

Scholarship Awards will be made on or about January 31, 2012

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

2011-2012 Renewal Form

Please fill out this form and attach your check made out to NCGS.

Mail to:

Phil Reed
NCGS Treasurer
488 Chaucer Circle
San Ramon, CA 94583-2542

Dues	
Regular ($ 15; email only)	**$__________**
Regular ($ 25; snail mail only)	**$__________**
Student ($ 5; email only)	**$__________**
Contribution	
Scholarship	**$__________**
Teacher Award	**$__________**
Total	**$__________**

Please provide the following information:

Name: ____

E-mail:____

I can help with:

Programs_____ Field Trips_____ Newsletter_____ Web Site_____

K-12 Programs_____ Scholarships_____ AAPG Delegate_____ Membership_____

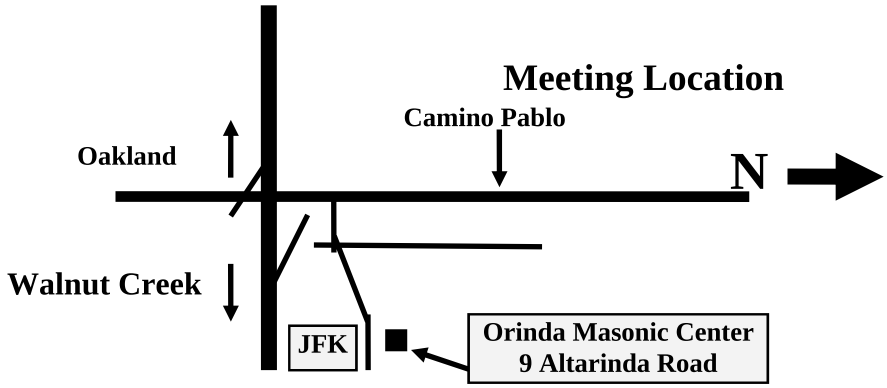
Please complete the following *only* if there are changes since last year:

Address ____

City, State, Zip____

Phone: Home (____)_________________Work (____)_____________Fax (____)_______________

Employer _________________________________Job Title__________



Biography: Dr. William E. (Bill) Motzer, Ph.D., PG, CHG has 37 years of experience as a Professional Geologist and more than 25 years of experience in conducting surface, subsurface, and environmental forensic geochemical investigations. He is a recognized expert in forensic geochemistry, with particular expertise in stable and other isotopic "fingerprinting" and age dating techniques and water quality/contaminant geochemistry, particularly in MTBE, NDMA, PPCPs, perchlorate, chromium(VI), arsenic, lead, mercury, and nitrate issues. Bill has conducted more than 400 environmental and water quality projects throughout California and other western states particularly for water districts, municipalities, and state agencies. Additionally, he has 15 years experience as a minerals/mining exploration geologist, specializing in base and precious metal deposits and has been retained as an expert witness for mine litigation issues. He has contributed to several book chapters and is the author of numerous journal articles. Bill served as the 2007-2008 San Francisco Bay Branch President of the Groundwater Resources Association of California (GRA); he regularly contributes articles to GRA's on-line publication *HydroVisons*, and is also Co-chair of GRA's Technical Committee. He is Vice President for the International Society of Environmental Geochemistry and Health (2010-2011) and is also the 2011-2012 Chair for the Northern California Section of the Society for Mining, Metallurgy, & Exploration (SME), and is a contributing editor for the California Section of American Chemical Society on-line newsletter *The Vortex*.

Time to Renew!
Please Use Attached Form (Thanks!)

Northern California Geological Society
c/o Mark Detterman
3197 Cromwell Place
Hayward, CA 94542-1209

Would you like to receive the NCGS newsletter by e-mail? If you are not already doing so, and would like to, please contact **Rob Nelson** at **rlngeology@sbcglobal.net** to sign up for this free service.