

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY



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MEETING ANNOUNCEMENT

DATE: April 29, 2015

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. Robert B. Miller, Professor and
Chair of Geology, San Jose State
University**

CONSTRUCTION, EMPLACEMENT, AND STRUCTURES OF PLUTONS AND THEIR IMPORTANCE: INSIGHTS FROM THE SIERRA NEVADA BATHOLITH AND NORTH CASCADES (WASHINGTON)

Much insight has been gained during the last 25 years into processes operating during the construction of plutons, and the evolution of these magmatic systems at their level of emplacement. Despite these advances, numerous controversies remain, including the numbers of magmatic increments which form a pluton and the sizes of magma chambers in plutonic systems. Other questions revolve around the origin of magmatic structures (e.g., foliations) in plutons. Many of these issues have been addressed through detailed study of plutons in the Sierra Nevada arc, and particularly the Tuolumne intrusive complex in Yosemite National Park.

In this talk, I provide insights into these problems on the basis of research conducted by San Jose State faculty and students in the central part of the Sierra Nevada batholith (Desolation Wilderness south to Yosemite Valley), including the Tuolumne intrusive complex, and in the North Cascades (WA). Our observations demonstrate a wide variety of styles of construction and emplacement, which likely reflect markedly different magmatic systems. These differences in part record differences in exposed crustal levels between the North Cascades (~30-5 km paleodepth) and the central Sierra Nevada batholith (~10 km paleodepth).

Biography: **Dr. Robert Miller** reports that he is a Professor and Chair of Geology at San Jose State where he has taught structural geology, tectonics, and field camp for 31 years. He received his B.S. degree in Geology from Allegheny College (Pennsylvania) and his Ph.D. from the University of Washington in 1980. His research has largely focused on the tectonic evolution of the North Cascades and the structure of plutons in the Sierra Nevada and Cascades. His Ph.D. was on an ophiolite in the Cascades and he has worked on and off on ophiolites since then, including in Oman.

NCGS 2014 – 2015 Calendar

May 27, 2015 **DINNER MEETING; 6:00 pm**

B. Lynn Ingram, UC Berkeley
The West without Water

June 24, 2015 **7:00 pm**

Dr. Will Schweller, NCGS President and Consultant
Injected Sands – Mother Nature's Giant Frac Job?

September 30, 2015 **7:00 pm**

TBD

October 28, 2015 **7:00 pm**

TBD

November 18, 2015 **(1 Week Early) 7:00 pm**

TBD

NCGS Field Trips

Saturday April 25, 2015

An undefined Petroleum system along the Santa Cruz County coast, California

Dr. Allegra Hasford Scheirer and Dr. Leslie B. Magoon, Stanford University, Stanford

July 25, 2015

The Geysers - Geothermal Energy

Fall 2015

Anatomy and provenance of a deep-water boulder conglomeratic submarine canyon in the Upper Cretaceous Panoche Formation (Cenomanian), Great Valley Group, San Luis Reservoir, central California-

Dr. Todd J. Greene, Department of Geological and Environmental Science, California State University, Chico

Additional Trips in Preliminary Planning Stage -

- Geology of Devil's Slide
- Pt. Sal Ophiolite in Santa Barbara Co,
- Convergent Margin Tectonics across Central California Coast Ranges - Pacheco Pass
- Tuscan Formation volcanic mudflow deposits, Cascade foothills

Peninsula Geologic Society

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

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). Go to: <http://www.bayareascience.org/>

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/>.

Seeking Member Write-Ups

Have you recently gone to, or seen an interesting geologic feature, event, or...? Let us know! NCGS would like to diversify the content of the newsletter and we want to make sure you know that your articles are welcome. There may be some editing for length, content, or grammar, but we want to welcome your articles! Send them to Mark Detterman at mdetter1@gmail.com. Our members will thank you!

New NCGS Outreach Committee

NCGS member **John Christian** was recently elected as Chair of the NCGS Outreach Committee. Over the last several years John has been instrumental in obtaining a booth and staffing the booths on behalf of NCGS at many local shows including annual Gem and Mineral Society shows and at booths at the American Geophysical Union (AGU) public open day events. These events have brought in a number of new members and have raised the profile of the NCGS locally as a source of geologic information. If you have an interest in discussing geology, rocks, gems and minerals, and educating the general interested public in all matters geologic, please let John know and he will likely find an interesting event for your consideration! You can reach him at jmc62@sbcglobal.net.

NCGS Looking for Cal Day Volunteers

John reports that we have tables for NCGS outreach at UC Berkeley's Cal Day, Saturday, April 18th in the geology building, McCone Hall. Please sign up with John to help staff the table from 9AM to 3:45PM. Please let him know what 2 or 3 hour time period you can help.

If we have enough support, everyone should have enough time to see the free events that nearly every department has. His favorites include the tour of the seismology lab, the tour of the fossils inside the Paleontology Museum and the botanical garden. There are also rumors that UC might open the Campanile for a tour of the 20 tons of LA Brea tar pit fossils. Please contact John soon.

Wanted - Newsletter Editor!

At the January 2015 Board Meeting NCGS newsletter editor **Mark Detterman** announced that he is seeking fresh eyes and new blood to pick up the editing of the NCGS newsletter beginning in September 2015. He plans to continue managing the NCGS website, unless better laid plans are put forward! **If you have wanted to contribute to the NCGS, please step up and let him know!**

California's First Analytical Chemist?¹

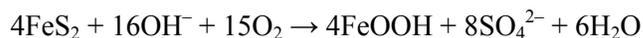
By NCGS Member **Dr. Bill Motzer**

This article originally appeared in The Vortex from the California Section of the American Chemical Society (CALACS). Go to <http://calacs.org/calacs> where you can download pdfs of the original articles and/or peruse past issues of The Vortex.

On the morning of January 24, 1848, James W. Marshall was examining the tail race of a new lumber mill that he was building for John A. Sutter to provide lumber for a new flour mill at Sutter's Fort in Sacramento. The new lumber mill was located on the South Fork of the American River in what is now Coloma, California in El Dorado County about 54 miles northeast of Sacramento. Marshall was concerned that the mill race was not deep enough to drive the water wheel which powered the saws. On the day before, he had his workers deepen the race and then open the forebay gates allowing water to run through the deepened channel to clear out excess excavated sand and gravel. During his examination he noted several small golden "pebbles." He suspected that they were gold nuggets but had never seen gold. One crew member that could recognize gold was the wife of Peter Wimmer, who was Marshall's assistant in charge of the Mormon and Indian workers digging the mill race. His wife, Jennie was employed as camp cook. So Marshall and Peter Wimmer took one of the small nuggets to Jennie to verify that it was indeed gold.

Elizabeth Jane "Jennie" Cloud Wimmer could recognize gold because she had panned for placer gold in the creeks near Auraria in Lumpkin County, Georgia. Gold had been discovered in 1799 in Virginia in what became the Carolina Slate Belt, a northeast-southwest zone extending from Virginia to Georgia and containing small gold deposits. In 1838, when Jennie was 16 years old, her family moved to north Georgia from Virginia. To help with the family's meager finances, her father, Martin Cloud, prospected for gold assisted by his daughter. She also knew several tests to determine if the ≈ 9.5 g ($\frac{1}{3}$ oz) nugget was actually gold or fool's gold (pyrite or FeS_2). So when Marshall brought her the nugget, she promptly threw it into the pot of lye that she was using to make laundry soap for the camp. In those

days "lye" (which is normally sodium hydroxide or NaOH) was made by soaking hard wood ashes (potash) in boiling water to leach out both potassium hydroxide (KOH) and potassium carbonate (K_2CO_3). Gold, of course, is not affected or dissolved by either hot KOH or K_2CO_3 , but pyrite is and one possible reaction is:

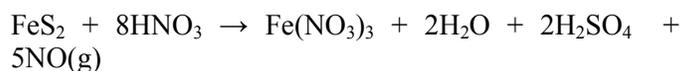


(pyrite)

("goethite")

The next morning, Jennie retrieved the intact nugget and pronounced that it was indeed gold. However, there had been much skepticism by camp workers concerning Marshall's find, many believing that the nuggets were only mica or pyrite. And, what did Jennie know? She was only the camp cook and a woman. Apparently, Jennie had made few friends with the workers because she insisted that they be on time when dinner was served or they would get no dinner.

On being informed by Jennie that the nuggets were indeed gold, Marshall wasted no time, immediately leaving on horseback for Sutter's Fort. He took the gold nuggets directly to Sutter who subjected them to several tests including hammering (they were malleable and not brittle, which pyrite is), weighing them and comparing their specific gravity against silver (gold, 19.3; silver, 10.5), and then exposing them to *aqua fortis* (nitric acid) that he had in his apothecary. Gold does not react with nitric acid (but will if hydrochloric acid is added to nitric acid forming *aqua regia*). However, pyrite does react with nitric acid and one possible reaction is:



Sutter concluded that the nuggets were gold and estimated their fineness at 23 out of 24 carats ($\approx 95\%$ Au). Both Marshall and Sutter wanted to keep the discovery secret and Marshall left that night in a rainstorm for Coloma to be joined the next day by Sutter. At the mill, Sutter gave each worker a pocket knife pledging them to secrecy. However, such a discovery could not be kept secret and it was inadvertently leaked to the public by one of Wimmer's children, who told a teamster delivering a wagon load of supplies Coloma camp. At Sutter's Fort, the teamster shared the news at Charlie Smith's store. Smith told his partner, Samuel Brannan, who owned a San Francisco newspaper. The Coloma gold discovery began appearing periodically in the news, with a special edition sent East by pony express. By the spring of 1848, coastal California towns were literally deserted with men abandoning farms, shops, and ships, flocking to the foothills carrying frying pans and spoons for panning. In December 1848, President James K. Polk announced the discovery in a joint session of Congress and the great 1849 California Gold Rush was on.

¹ Published in the November 2011 issue of *The Vortex* (v. LXXII, n. 9, pp. 7 and 9), newsletter of the Northern California Section of the American Chemical Society



Photo of James W. Marshall monument at Marshall Gold Discovery State Historic Park in Coloma, CA. Photo by W.E. Motzer, August 2011

Marshall eventually had a large monument erected to him at Coloma; it's at the Marshall Gold Discovery State Historic Park. However, Jennie Wimmer was almost forgotten as one of California's gold discoverers. It is not known when she died; but it may have been in 1885, at the age of 66. She's buried in Valley Center Cemetery, a pioneer's cemetery, in San Diego County. Her grave was originally marked by only a small brick, simply inscribed as "Mrs. Weamer." In 1948, a local Boy Scout troop had a project identifying and marking all of the cemetery's unmarked graves. On October 5, 2003, the Valley Center Historical Society and San Diego County, replaced the brick with a bronze memorial marker containing her story. The marker reads:



Photo of Elizabeth Jane (Jennie) Cloud Wimmer memorial plaque at Valley Center Pioneer Cemetery, San Diego, County, CA. Photo from <http://www.findagrave.com/cgi-bin/fg.cgi?page=pv&GRid=8361484&PIpi=2264097>

"Elizabeth Jane (Jennie) Cloud Wimmer involved in the single most important event in California history, the discovery of gold at Sutter's Mill on January 24, 1848. Her husband Peter and mill

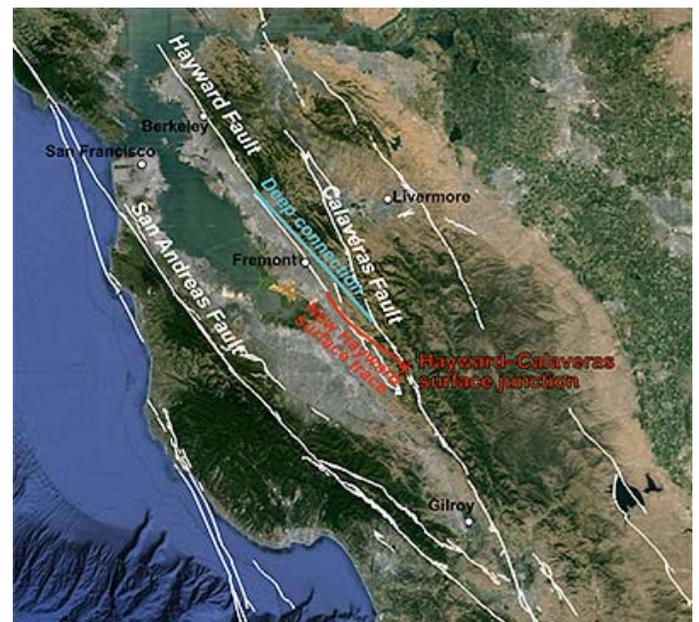
foreman James Marshall found a nugget on the American River and gave it to Jennie, a cook and housekeeper, to test in a kettle of soap. The next day, she declared that the nugget was gold. The famed California Gold Rush began. With James Marshall, she is credited as the codiscoverer of California Gold. An account by Captain John Sutter refers to the gem as the Wimmer nugget."

Marshall had given Jennie the tested nugget as a keepsake. She kept it all of her life and it eventually ended up in the University of California's Bancroft Library in Berkeley. Moral to this story is that when your wife (or the camp cook) tells you it's gold, believe her.

Calaveras-Hayward fault link means potentially larger quakes

By [Robert Sanders](#), UC Berkeley News Center, Media Relations | April 2, 2015

BERKELEY —UC Berkeley seismologists have proven that the Hayward Fault is essentially a branch of the Calaveras Fault that runs east of San Jose, which means that both could rupture together, resulting in a significantly more destructive earthquake than previously thought.



The Bay Area fault system and the spot (red star) where the Hayward Fault branches off from the Calaveras Fault. The white lines indicate faults recognized by the USGS. The red line is the newly discovered surface trace connecting the southern end of the Hayward Fault to the Calaveras Fault, once thought to be an independent system. The surface trace is offset by several kilometers from the deep portion of the fault 3-5 km below ground (blue line). (Estelle Chaussard image, UC Berkeley)

"The maximum earthquake on a fault is proportional to its length, so by having the two directly connected, we can have a rupture propagating across from one to the other, making a larger quake," said lead researcher Estelle Chaussard, a postdoctoral fellow in the Berkeley

Seismological Laboratory. “People have been looking for evidence of this for a long time, but only now do we have the data to prove it.”

The 70-kilometer-long Hayward Fault is already known as one of the most dangerous in the country because it runs through large population areas from its northern limit on San Pablo Bay at Richmond to its southern end south of Fremont.

In an update of seismic hazards last month, the U.S. Geological Survey estimated a 14.3 percent likelihood of a magnitude 6.7 or greater earthquake on the Hayward Fault in the next 30 years, and a 7.4 percent chance on the Calaveras Fault.

These estimates are based on the assumption that the two faults are independent systems, and that the maximum quake on the Hayward Fault would be between magnitudes 6.9 and 7.0. Given that the Hayward and Calaveras faults are connected, the energy released in a simultaneous rupture could be 2.5 times greater, or a magnitude 7.3 quake.

“A rupture from Richmond to Gilroy would produce about a 7.3 magnitude quake, but it would be even greater if the rupture extended south to Hollister, where the Calaveras Fault meets the San Andreas Fault,” Chaussard said.

Chaussard and her colleagues, including Roland Bürgmann, a UC Berkeley professor of earth and planetary science, report their findings in a paper accepted today (April 2) by the journal *Geophysical Research Letters*.

Creep connects two faults

Chaussard said there has always been ambiguity about whether the two faults are connected. The Hayward Fault ends just short of the Calaveras Fault, which runs about 123 kilometers from north of Danville south to Hollister in the Salinas Valley.

The UC Berkeley team used 19 years of satellite data to map ground deformation using interferometric synthetic aperture radar (InSAR) and measure creep along the southern end of the Hayward Fault, and found, surprisingly, that the creep didn’t stop south of Fremont, the presumed southern end of the fault, but continued as far as the Calaveras Fault.

“We found that it continued on another 15 kilometers and that the trace merged with the trace of the Calaveras Fault,” Chaussard said. In addition, seismic data show that micro-earthquakes on these faults 3-5 kilometers underground also merge. “With this evidence from surface creep and seismicity, we can argue for a direct junction on the surface and at depth for the two faults.”

Both are strike-slip faults – the western side moves northward relative to the eastern side. The researchers found that the underground portion of the Hayward Fault meets the Calaveras Fault 10 kilometers farther north

than where the creeping surface traces of both faults meet. This geometry implies that the Hayward Fault dips at an angle where it meets the Calaveras Fault.

InSAR revolutionizes mapping

Chaussard said that the 19 years of InSAR data, which came from the European Space Agency’s ERS and Envisat satellites between 1992 to 2011, were critical to connecting the two faults.

Creep, or the surface movement along a fault, is evidenced by offset curbs, streets and home foundations. It is normally determined by measuring the location of points on opposite sides of a fault every few years, but that is hard to do along an entire fault or in difficult terrain. InSAR provides data over large areas even in vegetated terrains and outside of urban areas, and with repeated measurements over many years InSAR can detect deformation with a precision of 2 millimeters per year.

“With InSAR, we have access to much larger spatial coverage,” said Chaussard, who has been expanding the uses of InSAR to measure water resources and now ground deformation that occurs between earthquakes. “Instead of having a few points, we have over 200,000 points in the Bay Area. And we have access to areas we couldn’t go to on the ground.”

She noted that while creep relieves stress on a fault gradually, eventually the surface movement must catch up with the long-term underground fault movement. The Hayward Fault moves at about 10 millimeters per year underground, but it creeps at only 3 to 8 millimeters per year. Earthquakes occur when the surface suddenly catches up with a fault’s underground long-term movement.

“Creep is delaying the accumulation of stress needed to get to an earthquake, but it does not cancel the earthquake,” Chaussard said.

Other co-authors are seismologists Robert Nadeau, Taka’aki Taira and Ingrid Johanson, as well as graduate student Chris Johnson, all of UC Berkeley; and Heresh Fattahi of the University of Miami in Florida. The work was supported by NASA and the USGS.

Related Information

- [Potential for larger earthquakes in the East San Francisco Bay Area due to the direct connection between the Hayward and Calaveras Faults \(GRL\)](#)
- [Berkeley Seismological Laboratory](#)
- [New Long-Term Earthquake Forecast for California \(March 10, 2015\)](#)

Archivists unearth rare first edition of the 1815 'Map that Changed the World'



William Smith 1815 map c. The Geological Society

A rare early copy of William Smith's 1815 Geological Map of England and Wales, previously thought lost, has been uncovered by Geological Society archivists. The new map has been digitised and made available online in time for the start of celebrations of the map's 200th anniversary, beginning with an unveiling of a plaque at Smith's former residence by Sir David Attenborough.

The map, the first geological map of a nation ever produced, shows the geological strata of England, Wales and part of Scotland. The newly discovered copy is thought to have been one of the first ten produced by William Smith (1769-1839), who went on to produce an estimated 370 hand-coloured copies of the map in his lifetime.

Now fully restored and digitised, images of the new map can be viewed on the Geological Society's image library from March 23 -- William Smith's birthday. It will also be on display at the Geological Society during a number of events celebrating the map's bicentennial.

Often called 'the Father of English Geology', William Smith pioneered the science of stratigraphy and geological mapping. His map of England and Wales became the basis for all future geological maps of Britain, and influenced geological surveys around the world.

'Smith's importance to the history of our science cannot be overstated' says John Henry, Chair of the Geological Society's History of Geology Group. 'His map is a remarkable piece of work. It helped shape the economic and scientific development of Britain, at a time before geological surveys existed.'

Smith's story was popularised by Simon Winchester's 2001 book, 'The Map that Changed the World', which tells the story of his relationship with the Geological Society, who produced their own geological map of Britain in 1820.

'These maps are extremely rare' says Henry. 'Each one is a treasure, and to have one of the very first produced is tremendously exciting.'

Although it is difficult to estimate the value of individual William Smith maps, an early copy was recently made available for sale at £150,000. The newly discovered map was found by the Society's then Archive Assistant Victoria Woodcock in 2014, during an audit of the Society's archives led by Geological Society Archivist Caroline Lam.

'The map was found among completely unrelated material, so at first I didn't realise the significance of what I'd uncovered' says Woodcock. 'Once we had worked out that it was an early copy of one of the earliest geological maps ever made, I was astonished. It's the kind of thing that anyone working in archives dreams of, and definitely the highlight of my career so far!'

The map was identified as a first edition due to its lack of serial number, and geological features which Smith was known to have updated on later versions.

'The very first batch of maps Smith produced did not have a series number or signature' says Henry. 'Other indications that it is a first edition is the geology depicted on the Isle of Wight, the lack of an engraved line on the Welsh border, and lack of granite around Eskdale in the Lake District.'

Records of the Geological Society's Council minutes from 1815 suggest the map was purchased by the Society in that year for the sum of £5 5s. Since then, its 'disappearance' means it has rarely been exposed to light, preserving the incredibly bright original colours.

A number of organisations, including the Geological Society, the Natural History Museum, the British Geological Survey and National Museum Wales, are joining together throughout 2015 to celebrate the bicentennial of William Smith's map through a range of events.

'We're incredibly excited by the discovery' says Geological Society President Professor David Manning. 'It's wonderful that the map has been restored and made publicly available in time for the bicentennial celebrations, and we're very grateful to the sponsors who have made this possible.'

Story Source: The above story is based on materials provided by Geological Society of London.

A Russian 'Doctor of Military Sciences' says Moscow should just nuke Yellowstone if tensions boil over

By Amanda Macias April 1, 2015, *Business Insider*

(Editor's Note: After last month's excellent talk on Yellowstone by Dr. Jake Lowenstern, US Geological Survey, this news article seemed like an interesting counterpoint!)

Earlier this week, the Russian president of the Academy of Geopolitical Problems outlined two geophysically weak US regions to attack in order to combat NATO's aggression toward Russia.

In his [article](#), Konstantin Sivkov justifies the option of "complete destruction of the enemy" because NATO has been "moving to the borders of Russia."

Sivkov, listed as a "Doctor of Military Sciences," described scenarios that involved dropping a nuclear weapon near Yellowstone's supervolcano or the San Andreas Fault.

Catalyze the eruption of Yellowstone's supervolcano



(Screen grab/Discovery Channel) Computer generated image of an eruption in Yellowstone. In the past 2.1 million years, Yellowstone's volcano has violently erupted three times and "blanketed parts of the North American continent with ash and debris," according to the [US Geological Survey](#).

Some scientists argue that Yellowstone's active supervolcano is long overdue for a colossal eruption.

"Geologists believe that the Yellowstone supervolcano could explode at any moment. There are signs of growing activity there. Therefore it suffices to push the relatively small, for example the impact of the munition megaton class to initiate an eruption. The consequences will be catastrophic for the United States, a country just disappears," he said, according to a translation by Sydney Morning Herald.

According to a Discovery Channel [documentary](#), an eruption of this magnitude would bury North America, drape the atmosphere in a sulfur haze, dim sunlight, and plunge the world into a volcanic winter.

Trigger a mega tsunami to ruin America's infrastructure



(Screen grab/YouTube) Computer generated image. Another option would be to drop a nuclear bomb near California's San Andreas Fault. "A detonation of a nuclear weapon there can trigger catastrophic events like a coast-scale tsunami which can completely destroy the infrastructure of the United States," he said, according to the Sydney Morning

Herald's [translation](#).

Since last year's illegal annexation of Crimea, Russian President Vladimir Putin has responded to international criticism and economic sanctions placed on his country by flexing his nation's military muscle around the world.

The crisis in Ukraine reflects a turning point in NATO's stance on Putin and emphasizes a growing concern stemming from the origins of NATO, which was formed for collective territorial defense.

"He wants to restore the Russian empire ... I don't know where he'll stop," Senator John McCain (R-Arizona) said of Putin earlier this month during a speech at the Center for Strategic International Studies.

Scientists discover elusive secret of how continents formed

An international research team, led by a Virginia Tech geoscientist, has revealed information about how continents were generated on Earth more than 2.5 billion years ago -- and how those processes have continued within the last 70 million years to profoundly affect the planet's life and climate.

Published online today in *Nature Geoscience*, the study details how relatively recent geologic events -- volcanic activity 10 million years ago in what is now Panama and Costa Rica -- hold the secrets of the extreme continent-building that took place billions of years earlier.

The discovery provides new understanding about the formation of the Earth's continental crust -- masses of buoyant rock rich with silica, a compound that combines silicon and oxygen.

"Without continental crust, the whole planet would be covered with water," said Esteban Gazel, an assistant

professor of geology with Virginia Tech's College of Science. "Most terrestrial planets in the solar system have basaltic crusts similar to Earth's oceanic crust, but the continental masses -- areas of buoyant, thick silicic crust -- are a unique characteristic of Earth."

The continental mass of the planet formed in the Archaean Eon, about 2.5 billion years ago. The Earth was three times hotter, volcanic activity was considerably higher, and life was probably very limited.

Many scientists think that all of the planet's continental crust was generated during this time in Earth's history, and the material continually recycles through collisions of tectonic plates on the outermost shell of the planet.

But the new research shows "juvenile" continental crust has been produced throughout Earth's history.

"Whether the Earth has been recycling all of its continental crust has always been the big mystery," Gazel said. "We were able to use the formation of the Central America land bridge as a natural laboratory to understand how continents formed, and we discovered while the massive production of continental crust that took place during the Archaean is no longer the norm, there are exceptions that produce 'juvenile' continental crust."

The researchers used geochemical and geophysical data to reconstruct the evolution what is now Costa Rica and Panama, which was generated when two oceanic plates collided and melted iron- and magnesium-rich oceanic crust over the past 70 million years, Gazel said.

Melting of the oceanic crust originally produced what today are the Galapagos islands, reproducing Achaean-like conditions to provide the "missing ingredient" in the generation of continental crust.

The researchers discovered the geochemical signature of erupted lavas reached continental crust-like composition about 10 million years ago. They tested the material and observed seismic waves traveling through the crust at velocities closer to the ones observed in continental crust worldwide.

Additionally, the researchers provided a global survey of volcanoes from oceanic arcs, where two oceanic plates interact. The western Aleutian Islands and the Iwo-Jima segment of the Izu-Bonin islands of are some other examples of juvenile continental crust that has formed recently, the researchers said.

"This is an interesting paper that makes the case that andesitic melts inferred to derive ultimately by melting of subducted slabs in some modern arcs are a good match for the composition of the average continental crust," said Roberta L. Rudnick, a Distinguished University Professor and chair of the Department of Geology at the University of Maryland, who was not involved in conducting the research. "The authors focus primarily on Central America, but incorporate global data to strengthen their case that slab melting is

important in unusual conditions of modern continent generation -- and probably in the past."

The study raises questions about the global impact newly generated continental crust has had over the ages, and the role it has played in the evolution of not just continents, but life itself.

For example, the formation of the Central American land bridge resulted in the closure of the seaway, which changed how the ocean circulated, separated marine species, and had a powerful impact on the climate on the planet.

"We've revealed a major unknown in the evolution of our planet," said Gazel, who was the senior and corresponding author of the study.

Story Source: The above story is based on materials provided by Virginia Tech.

Journal Reference: Esteban Gazel, Jorden L. Hayes, Kaj Hoernle, Peter Kelemen, Erik Everson, W. Steven Holbrook, Folkmar Hauff, Paul van den Bogaard, Eric A. Vance, Shuyu Chu, Andrew J. Calvert, Michael J. Carr, Gene M. Yogodzinski. **Continental crust generated in oceanic arcs.** *Nature Geoscience*, 2015; 8 (4): 321 DOI: [10.1038/ngeo2392](https://doi.org/10.1038/ngeo2392)

Whale fossil, 17 million years old, provides first exact date for East Africa's puzzling uplift



A 17-million-year-old whale fossil stranded far inland in Kenya now sheds light on the timing and starting elevation of East Africa's puzzling tectonic uplift, says paleontologist Louis Jacobs, Southern Methodist University, Dallas, who rediscovered the fossil. Credit: Southern Methodist University

Uplift associated with the Great Rift Valley of East Africa and the environmental changes it produced have puzzled scientists for decades because the timing and starting elevation have been poorly constrained.

Now paleontologists have tapped a fossil from the most precisely dated beaked whale in the world -- and the only stranded whale ever found so far inland on the African continent -- to pinpoint for the first time a date when East Africa's mysterious elevation began.

The 17 million-year-old fossil is from the beaked Ziphiidae whale family. It was discovered 740 kilometers inland at an elevation of 620 meters in modern Kenya's harsh desert region, said vertebrate paleontologist Louis L. Jacobs, Southern Methodist University, Dallas.

At the time the whale was alive, it would have been swimming far inland up a river with a low gradient ranging from 24 to 37 meters over more than 600 to 900 kilometers, said Jacobs, a co-author of the study.

The study, published in the *Proceedings of the National Academy of Sciences*, provides the first constraint on the start of uplift of East African terrain from near sea level.

"The whale was stranded up river at a time when east Africa was at sea level and was covered with forest and jungle," Jacobs said. "As that part of the continent rose up, that caused the climate to become drier and drier. So over millions of years, forest gave way to grasslands. Primates evolved to adapt to grasslands and dry country. And that's when -- in human evolution -- the primates started to walk upright."

Identified as a Turkana ziphiid, the whale would have lived in the open ocean, like its modern beaked cousins. Ziphiids, still one of the ocean's top predators, are the deepest diving air-breathing mammals alive, plunging to nearly 10,000 feet to feed, primarily on squid.

In contrast to most whale fossils, which have been discovered in marine rocks, Kenya's beached whale was found in river deposits, known as fluvial sediments, said Jacobs, a professor in the Roy M. Huffington Department of Earth Sciences of SMU's Dedman College of Humanities and Sciences. The ancient large Anza River flowed in a southeastward direction to the Indian Ocean. The whale, probably disoriented, swam into the river and could not change its course, continuing well inland.

"You don't usually find whales so far inland," Jacobs said. "Many of the known beaked whale fossils are dredged by fishermen from the bottom of the sea."

Determining ancient land elevation is very difficult, but the whale provides one near sea level.

"It's rare to get a paleo-elevation," Jacobs said, noting only one other in East Africa, determined from a lava flow.

Beaked whale fossil surfaced after going missing for more than 30 years

The beaked whale fossil was discovered in 1964 by J.G. Mead in what is now the Turkana region of northwest Kenya.

Mead, an undergraduate student at Yale University at the time, made a career at the Smithsonian Institution, from which he recently retired. Over the years, the Kenya whale fossil went missing in storage. Jacobs, who was at one time head of the Division of Paleontology for the National Museums of Kenya, spent 30 years trying to locate the fossil. His effort paid off in 2011, when he rediscovered it

at Harvard University and returned it to the National Museums of Kenya.

The fossil is only a small portion of the whale, which Mead originally estimated was 7 meters long during its life. Mead unearthed the beak portion of the skull, 2.6 feet long and 1.8 feet wide, specifically the maxillae and premaxillae, the bones that form the upper jaw and palate.

The researchers reported their findings in "A 17 million-year-old whale constrains onset of uplift and climate change in East Africa" online at the *PNAS* web site.

Modern cases of stranded whales have been recorded in the Thames River in London, swimming up a gradient of 2 meters over 70 kilometers; the Columbia River in Washington state, a gradient of 6 meters over 161 kilometers; the Sacramento River in California, a gradient of 4 meters over 133 kilometers; and the Amazon River in Brazil, a gradient of 1 meter over 1,000 kilometers.

Story Source: The above story is based on materials provided by Southern Methodist University.

Journal Reference: Henry Wichura, Louis L. Jacobs, Andrew Lin, Michael J. Polcyn, Fredrick K. Manthi, Dale A. Winkler, Manfred R. Strecker, Matthew Clemens. **A 17-My-old whale constrains onset of uplift and climate change in east Africa.** *Proceedings of the National Academy of Sciences*, 2015; 201421502 DOI: [10.1073/pnas.1421502112](https://doi.org/10.1073/pnas.1421502112).

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

An undefined Petroleum system along the Santa Cruz County, California



NCGS FIELD TRIP - Saturday April 25, 2015

Field Trip Leaders:

Dr. Allegra Hasford Scheirer and Dr. Leslie B. Magoon

Department of Geological and Environmental Sciences, Stanford University, Stanford, California

Field Trip Director: Tridib Guha

Numerous asphalt-saturated sandstone deposits on and near the Santa Cruz County coast in central California confirm the presence of a previously undefined petroleum system. These asphalt occurrences lie about 25 to 50 km south-southeast of the La Honda Basin, where 5 small oil fields have produced nearly 2 million barrels of oil and 300 million cubic feet of gas. The close proximity of the Santa Cruz County coast to the petroleum system of the La Honda Basin indicates that similar elements are at work along the coast. The likely source rock for these asphalt deposits is California's "superstar" oil source rock, the Monterey Formation. It has been suggested that the Santa Cruz Mudstone overlying the Monterey Formation could also serve as a local petroleum source rock. However, the real importance of the Santa Cruz Mudstone is that it is the thickest of three overburden rocks that are required to thermally mature the underlying Monterey Formation. All this happens on the southern flank of the Ben Lomond Mountain, a persistent granitic and metamorphic high. The offset of the San Gregorio Fault plays a crucial role in determining the critical moment for this petroleum system.

To better understand the petroleum system in this area, we will investigate the migration pathways and reservoir rocks along the Santa Cruz county coast. At our first four stops, we will be standing on young marine terrace

deposits but looking primarily at Santa Cruz Mudstone, and to a lesser extent, Santa Margarita Sandstone. There are no exposures of the Monterey Formation along the coast in our field trip area.

A major geologic feature of the Santa Cruz County Coast is the sand injectite. On this field trip we will see a large subaerially exposed injectite complex at Yellow Bank and Panther beaches. Here, fluidized sand from the Santa Margarita Sandstone is injected upward into fractured Santa Cruz Mudstone. The emplacement of these intrusions was facilitated because deposition and induration of the Santa Cruz Mudstone increase confining pressure within underlying siliciclastic unit; stresses triggered the injection of sand into the lower pressured fractures in the mudstone.

We will also observe carbonate concretions on the beach in the city of Santa Cruz that mark the locations of fossil seafloor cold seeps. These vent structures closely resemble modern-day examples found on the floor of Monterey Bay. Both modern and fossil vent features appear to be closely associated with fault systems. The occurrence of carbonate slabs in areas of active hydrocarbon seepage is common in seafloor settings.

Please carpool/vanpool and share the ride and cost. We will circulate an attendees list for carpooling to the meeting place. No. geologic hammers are allowed!

THIS FIELD TRIP WILL BE LIMITED TO 30 PEOPLE.

Field Trip Logistics in preparation

Time & Meeting Place: April 25, 2015, 9:00 am at the meeting place (will be notified)

Cost: \$40/person, which includes a guidebook, morning coffee, muffins, lunch, and refreshments. No more plastic water bottles will be allowed on Field Trips! Please bring your own water bottle.

REGISTRATION FORM (Santa Cruz Field Trip)

Name: _____

E-mail: _____

Carpool origin Residence: _____

Phone: _____ Phone (alternate): _____

Check no./amount _____

Please indicate if you want drive a car and the # of people on ride share

Lunch: Regular: _____ Vegetarian _____
(Please check one)

Please mail registration with a check payable to NCGS:
Tridib Guha, 5016 Gloucester Lane, Martinez, CA 94553
Questions e-mail: tridibguha@yahoo.com Phone: 925-451-1999

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY



NCGS DINNER MEETING Wednesday May 27, 2015

6:00 PM at Orinda Masonic Center

“THE WEST WITHOUT WATER”

Speaker: Dr. B. Lynn Ingram, Professor of Geology, University of California, Berkeley

(Reservations are required by May 22, 2015, Limit 100 persons)
We are sorry but we will not be able to accommodate “walk-ins”

Stepping out of our normal routine, the **Northern California Geological Society** is pleased to announce this *special dinner and evening* with **Dr. Ingram**. For this unique event, planned for our normal monthly meeting date, but starting one-half hour early, we are planning in typical NCGS style, a **Back Forty Texas BBQ dinner consisting of Pork Ribs and BBQ Chicken, Tossed Green Salad, BBQ Beans, Fresh Corn Cobettes. For vegetarian dinners a deluxe veggie burger will be served in place of BBQ. Desert will include assorted cookies and brownies. We may be again serving wines from California specials (90 pts +).** Please also note that a vegetarian option is available if notified ahead (please see the registration form below).

Abstract:

The West without Water documents the tumultuous climate of the American West over twenty millennia, with tales of past droughts and deluges and predictions about the impacts of future climate change on water resources. Looking at the regions current water crisis from the perspective of its climate history, the authors ask the central question of what is “normal” climate for the West, and whether the relatively benign climate of the past century will continue into the future.

*******Dinner Logistics*******

Meeting Details: Social Hour: 6:00 – 7:00 pm; Dinner: 7:00 – 8:00 pm; **Presentation:** 8:00 – open

Time: May 27, 2015, 6:00 pm, Orinda Masonic Center 9 Altarinda Road, Orinda, CA.

Cost: \$25/person

*******REGISTRATION FORM (Dr. Ingram’s Dinner)*******

Name: _____

E-mail: _____

Phone (day): _____ Phone (cell) _____

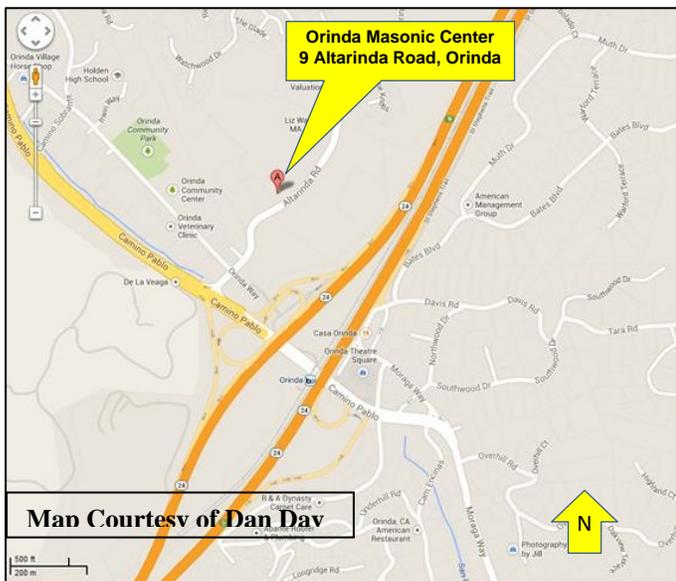
Dinner: Regular: _____ Vegetarian: _____ (Please check one) Check Amount: _____

Please mail a check made out to **NCGS** to:

Tridib Guha, 5016 Gloucester Lane, Martinez, CA 94553

Questions: e-mail: tridibguha@yahoo.com

Phone: (925) 451-1999



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 Ton Barry at tomasbarry@aol.com to sign up for this free service.