NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

MEETING ANNOUNCEMENT

DATE: **April 27, 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. Greg Croft (Speaker) and Dr. Tad Patzek**

Coal and the Peak of World Carbon Emissions

There are two quantitative approaches to estimating future coal production. One is to divide published reserves by production to estimate reserve life and the other is to fit a Hubbert curve to past production. The depth of working underground mine faces is a qualitative indicator, but it appears to support the Hubbert results. The value of an alternative approach is that it provides a reality check on the magnitude of carbon emissions in a business-as-usual scenario. The resulting base-case is significantly below 36 of the 40 carbon emission scenarios from the Intergovernmental Panel on Climate Change. The global peak of coal production from existing coalfields is predicted to occur close to the year 2011. The peak coal production rate is 160 EJ/y, and the peak carbon emissions from coal burning are 4.0 Gt C (15 Gt CO2) per year. After 2011, the production rates of coal and CO2 decline, reaching 1990 levels by the year 2037, and reaching 50% of the peak value in the year 2047. It is unlikely that future mines will reverse the trend predicted in this scenario.

This research has been published in the August 2010 issue of Energy (Elsevier) and has been cited by National Geographic and the New York Times

Dr. Greg Croft holds a BA in geology from the University of California Santa Barbara, an MS in geophysics from Stanford University and a PhD in civil and environmental engineering from the University of California Berkeley. After completing his MS, he worked in oil and gas exploration for Chevron Overseas Petroleum, Harrods Energy and as an independent consultant. During this time he published a number of articles on the oil resources of the Middle East and Venezuela. His research on global coal resources was part of his 2009 doctoral dissertation and has been published in the August 2010 issue of Energy (Elsevier Publishing). Dr. Croft teaches geology at Saint Mary's College and is a frequent public speaker on mineral resource assessment issues. He has previously presented Regional Trends in World Oil Production to the NCGS. (Dr. Croft will be speaking).

…continued on the back…

NCGS 2010 – 2011 Calendar

Wednesday May 25, 2011
DINNER MEETING! EARLY TIME!
Dr. Eldridge Moores
Assembling California: An Update
Also: ***The initiative on recognition of Earth Science for entrance into the University: an Update***
6:00 pm at Orinda Masonic Lodge

Wednesday June 29, 2011
Dr. John Wakabayahsi (Tentative)
Franciscan TBA
7:00 pm at Orinda Masonic Lodge

Our Usual Summer Break!

October 9 – 15, 2011
Earth Science Week
TBA

Upcoming NCGS Events

April 30, 2011 (Tentative)	Cantua Creek II; Dr. Mel Erskine
June 25 & 26, 2011	Geology of Lake Tahoe Region, Dr. Richard Schweickert, Emeritus, University of Nevada, Reno

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.

- May 10, 2011, Jorge Vazquez, USGS
- June 7, 2011, Jon Hagstrum, USGS, Presidential Address

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/

- April 28, 2011; Predictable Earthquakes; Susan Hough; http://online.wr.usgs.gov/calendar/2011/Apr11flyer.pdf
- May 26, 2011; Rare Earth Elements; Keith Long
- June 30, 2011; California Seafloor Mapping Program; Sam Johnson
- July 2011; Climate Variability/Change & SF Bay-Delta; Jim Cloern Ecosystem

Bay Area Science
(http://www.bayareascience.org/)

This website came to our attention recently and we wanted to pass the information along to members. The 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).

Link to Online Publication

For those who could not make it to last month's presentation by Dr. James G. Moore, we provide a link to the online version of the publication: ***Hand-Hewn Granite Basins at Native American Saltworks, Sierra Nevada, California.*** http://pubs.usgs.gov/sir/2009/5225/

Perhaps Old…

Remember the Cave of Crystals found in Mexico a number of years back? The following link to a PowerPoint (http://www.thatcrystalsite.com/caves.php) presentation was one of the first available views of the discovery. If you can manage the music (Enya), the shots are still amazing! For some reason it never got put in the newsletter. Perhaps this will inspire you to search out some of the video available online as well!

Japanese Tsunami Video

We also provide a link to a video by a Japanese photographer of the incoming tsunami. This is by far one of the best video's your editor has seen; it shows the power of a tsunami at a human scale. In this case the photographer keeps moving up the stairs to avoid the incoming wave. It starts simply enough…

http://www.youtube.com/watch_popup?v=c3rqPPJPwLg

2010-2011 K - 12 NCGS Teacher of the Year Award

One special Bay Area teacher was recently recognized and presented with a $750 award check as part of the 2010-11 NCGS' annual **Teacher of the Year (TOTY) Award.** NCGS is especially pleased to make the award to **Heather Marshall** due to her high interest in geology/earth science.

NCGS forwarded Ms. Marshall's application to PSAAPG for consideration for their AAPG TOTY award. **Heather has also now been named Pacific Section AAPG Teacher of the Year!**

Ms. Marshall currently teaches at Sobrato High School in Morgan Hill, CA. She graduated from California State University, Hayward, with a B.S. in Geology and has an MS in Science Education from U of Texas. She worked with the Energy Resources Team at the US Geological Survey for two years before becoming a high school science teacher in 2001. Heather started her teaching with 5 years in Texas before moving to Roseville High School, JUHSD, CA for 3 years and then Sobrato High School for the past year. She currently holds a Single Subject Teaching Credential in Geoscience/Earth Science and is working for a second MS, in Teachers in Geosciences at Mississippi State. Her yearlong Geology/Earth Science course covers the spectrum from Astronomy to Energy & Climate to Geology & Oceanography to Weather. Her materials cover class, labs and exercises.

Check out her website:
https://sites.google.com/site/cpgeology/

Ms. Marshall lives in Los Gatos, CA. Since 2008, she has served as the High School Director for the California Science Teachers Association. For Fun: she has two horses, two cats, two dogs, four chickens, a bearded dragon and fish. As you can see, she loves animals! In her spare time she likes to read, and train for triathlons and running events.

Join the Northern California Geological Society in Congratulating Heather Marshall On BOTH Awards!!

A Belated Thanks!

The NCGS editor owes (as do our members) a belated Thanks (!) to member **John Christian** for continuing to find and forward a good number of the articles that appear each month in the newsletter. As he always manages to do in the field, John also manages to find something everyone overlooked, as well as interesting or humorous geologic articles for our entertainment. Although he is now in Texas for an extended period, he is still contributing to the mix! He reports that he intends on providing write-ups on local (Texas) geology that we might find interesting.

Novel Technique Reveals How Glaciers Sculpted Their Valleys

ScienceDaily — The beautiful and distinctive U-shaped glacial valleys typical of alpine areas from Alaska to New Zealand have fascinated and frustrated geologists for centuries.

While it seems obvious that glaciers scoured the bedrock for millions of years, what the landscape looked like before glaciers appeared, and how the glaciers changed that landscape over time, have remained a mystery. The glaciers erased all the evidence.

Now, University of California, Berkeley, and Berkeley Geochronology Center (BGC) scientists have employed a clever technique to reconstruct the landform history of a 300-square-mile area of Fiordland in New Zealand, from the early Pleistocene some 2.5 million years ago, when the world cooled and glaciers formed, through today's warmer interglacial period.

"The first question we asked was, how much of the current landscape and relief is a result of glacial

erosion?" said David Shuster, who developed the novel technique, called helium-4/helium-3 thermochronometry. "The answer is, all of it."

Kurt Cuffey overlooking the glacier-carved Bowen River drainage (middle), Mount Tutoko (far right) and Milford Sound (left) in Fiordland National Park of New Zealand. (Credit: Photo by Johnny Sanders)

Shuster is an associate adjunct professor of earth and planetary science at UC Berkeley and a geochemist at the Berkeley Geochronology Center.

"Geologists have wondered, what did the landscape look like 200,000 years ago, or 400,000 years ago, or back before the Pleistocene glaciations began?" said glaciologist Kurt Cuffey, professor and chair of geography and a professor of earth and planetary science at UC Berkeley. "Did the valleys start out as V-shaped canyons submerged in ice, and the glacier just widened and deepened them? Or perhaps the relief was sculpted by glaciation, and it didn't matter what the rock landscape looked like before."

"David's work opens up a whole new world of investigation to tell us how the alpine landscape progressed, with implications for how glaciers today act on the landscape," he said.

Shuster, Cuffey, UC Berkeley graduate student Johnny Sanders and BGC researcher Greg Balco report their conclusions in the April 1 issue of the journal *Science*.

Glaciers carved their mouths first, then their heads

The team found that in the Fiordland, a well-known tourist destination in the Southern Alps of New Zealand, the rock currently on the surface was about 1.5 miles (2 kilometers) underground when the glaciers began forming about 2.5 million years ago. Since then, the mountains rose as a result of tectonic activity, while the glaciers flowed downhill, scouring the landscape and gouging U-shaped valleys on their way to the sea.

What surprised the geologists was that most of the valley-making occurred at the downstream mouths of glaciers for the first million years, essentially stopping about 1.5 million years ago. For the next million years, until about 500,000 years ago, erosion took place primarily at the heads of glaciers, which steadily ate into their headwalls, characterized by steep, amphitheater-like cirques. As a result, the deep valleys advanced up their drainage basins toward the range divide, producing razorback ridges in the process.

"Apparently, the heads of glaciers would be directly opposite one another on either side of a high ridge, and faster erosion at the headwalls caused the glaciers to eat their way inward to the spine of the mountain range, farther from the glacier's outlet," Cuffey said.

Major changes to the mountain topography essentially stopped about half a million years ago. The current interglacial period started about 12,000 years ago, after warming temperatures caused the glaciers to melt and recede. The fact that these Fiordland valleys are now ice-free allowed the researchers to collect surface rock samples from 33 sites in four glacial valleys over six days with the assistance of a helicopter. The valleys end in Milford Sound or Lake Te Anau.

Temperature as a proxy for depth

Shuster developed helium-4/helium-3 thermochronometry while a graduate student at Caltech, from which he obtained his Ph.D. in 2005. The technique makes it possible to determine the temperature of a mineral as it cooled over geological time. Because temperature increases with depth, the temperature history of the mineral tells how deeply it was buried over a period of millions of years.

"The technique allows us to collect samples from the present surface and, based on observations, infer how they cooled through 80 degrees Celsius to 20 degrees Celsius (176 to 68 Fahrenheit) over the last few million years, and thus, how deep they were when they cooled," Shuster said.

At the moment, the technique works only with crystals of apatite, a calcium phosphate mineral found mainly in plutonic rocks, such as granite, that solidify from magma deep underground. The apatite crystals contain uranium and thorium, which over millions of years decay radioactively, producing helium-4. The helium gradually leaks out of the crystal into the surrounding rock, but the rate of leakage decreases as the crystal cools.

Using special equipment at the BGC, the geologists were able to date the cooling of the minerals by measuring the amount of uranium and thorium in each crystal as well as the total amount of helium-4. The new technique involves irradiating the crystal with a

proton beam to create helium-3, then measuring the outgassing of both helium isotopes to obtain a cross section of the helium-4 concentration in the crystal. They then calculated the crystal's cooling history based on the helium diffusion rate.

The samples, all of them younger than 2.5 million years, showed a large range of temperature, and thus depth, histories. Cuffey and Shuster used a computer model to test various scenarios and concluded that only one fit the data: Glaciers initially scoured the U-shaped valleys on the flanks of the mountain range, and only later began eating away at their headwater regions, including cirques and drainage divides.

"… this morphology resembles modern analogs in Norway and Antarctica, where steep valley ramps descend to level floors," the authors wrote.

The common thread is that the rock erodes faster where the ice sits on a steep slope, they said. Thus, the erosion rate of a glacier is greatest where the flowing river of ice descends steeply downstream.

"This scenario is consistent with a subglacial erosion rate dependent on ice sliding velocity, but not ice discharge," Shuster said.

The research was supported by the National Science Foundation. The work of the BGC was supported by the Ann and Gordon Getty Foundation.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by University of California - Berkeley.

Journal Reference:

1. D. L. Shuster, K. M. Cuffey, J. W. Sanders, G. Balco. **Thermochronometry Reveals Headward Propagation of Erosion in an Alpine Landscape**. *Science*, 2011; 332 (6025): 84.

How Old Is the Grand Canyon?

Written by Wayne Ranney,
author of *Carving Grand Canyon: Evidence, Theories and Mystery.*

Introduction

The Grand Canyon is one of the most recognizable landforms on planet Earth and the most often asked question about it is, “When did it form?” If only there were a simply answer! Geologists still debate many of the details about the origin and age of the canyon but recent geologic research has shed new light on the topic. Using new, sophisticated laboratory techniques geologists are able to tease ever more information from the canyon’s seemingly stubborn rocks. To begin to grasp the age of the canyon we should also know something about the history of the Colorado River, for without this river (or at least some ancestor to it) there would be no Grand Canyon.

The Colorado River, or some ancestor to it, has carved the Grand Canyon. But as new techniques are developed to tease ever more information from the canyon's rocks, the age of the canyon becomes more of a puzzle. Traditionally, the age of the canyon is ascribed at 6 million years but this date refers specifically to when the modern Colorado River came into existence. Could a precursor to the Colorado River have initiated the cutting of the canyon? Some geologists think so.Click on the image to enlarge. Image © Wayne Ranney

The Early River

Geologists know that the canyon and the river had to have formed within the last 80 million years because this is when the sea was last present here. When the landscape was uplifted from this seabed, an initial river system developed and drained to the northeast, exactly opposite to the flow direction of the Colorado River today. The larger geologic setting of the American West at this time reveals that an Andean-type mountain range existed to the southwest of Grand Canyon near the modern-day cities of Las Vegas, Nevada; Kingman, Arizona; and Needles, California. This ancient range is where the ancestor of the Colorado River originated. As strange as this may sound, it is one of the few parts of the Colorado River story that all geologists agree upon.

An Early Canyon?

A new theory published in 2011 contends that this ancient northeast river system carved the Grand Canyon as early as 70 million years ago. Using a technique that can tell how deeply buried the canyon’s rocks were at specific time intervals, scientists

determined that western Grand Canyon was cut to within a few hundred meters of its present depth 70 million years ago, while eastern Grand Canyon (where most visitors see the canyon) was the site of a gorge of similar proportions to the modern canyon, but cut into Mesozoic-age rocks that are now

completely stripped away. This evidence flies in the face of many long held theories that the canyon is only about 6 million years old. The notion that the Grand Canyon could be old is not a completely new idea but the recent research uses more cutting-edge tools to arrive at this conclusion. Look for vigorous debate in the near future regarding this mind-blowing proposal.

Drainage Reversal

Beginning about 17 million years ago, the mountain range that fed the ancient northeast river system was destroyed by faulting, as the Basin and Range was created southwest of Grand Canyon. This is when the San Andreas Fault became active and it helped to rip apart the region that once held the lofty mountains. The through-going northeast drainage system was compromised, diverted or destroyed at this time, but very little evidence for where rivers were going at this time (30 to 17 million years) remains. Perhaps drainages were directed to the developing basins southwest of the Grand Canyon and if so, they might have taken advantage of previously established routes, routes that may have acted as a pre-existing "perforation" on the landscape. Or perhaps the new drainage pattern completely abandoned the old routes and carved new ones to its liking. We may never know because so little evidence remains from this enigmatic period in the canyon's history.

A Recent Colorado River and Grand Canyon

Support for a recent river and canyon comes from the area around the mouth of Grand Canyon (Grand Wash Cliffs) near Meadview, Arizona. The Muddy Creek Formation lies athwart the river's course here but has no recognizable Colorado River sediment within it – the interpretation is that the river was not in existence while the Muddy Creek Formation was accumulating. The deposit is as young as 6.0 million years and this is where the famous date for the canyon and the river is derived from. Just downstream are definitive Colorado River gravels that came from Grand Canyon and they are preserved beneath the Sandy Point basalt, dated at 4.4 million years. Taken together the evidence suggests that the river here is between 6.0 and 4.4 million years old and geologists have often conflated the age of the river as the age of the canyon. Some geologists think there was no part of the canyon in existence before 6.0 million years ago; others think it took much longer to form it.

What Process Formed Grand Canyon?

Two major processes are used to explain how the Grand Canyon formed - headward erosion and steam piracy, and basin spillover. Headward erosion and stream piracy is the historical favorite but few studies have come to its defense in recent decades. Basin spillover is currently receiving a lot of attention, especially for the lower Colorado

River between Hoover Dam and Yuma, Arizona

Geologists have documented a series of closed basins that filled rapidly with river water, spilling over their lowest rims to stitch together the Las Vegas, Cottonwood, Mojave, and Chemehuevi basins, all between 5.6 and 4.1 million years ago. They naturally wondered what caused the rapid arrival of water to these basins and of course, looked figuratively and literally upstream towards the Grand Canyon. We may never know but that is part of the beauty of this marvelous place.

As a final note, remember that what constitutes a "beginning" to the Grand Canyon hinges on a definition of what it is. Can its beginning be defined as when the earliest river eroded into any Grand Canyon strata? What if those same rivers sliced into strata now completely gone? What if a river going in the other direction cut the canyon? Would that still be considered Grand Canyon? Or is the definition completely dependent on a canyon being cut by the exact same river we see today? The definition of "beginning" seems to be a moving target and will aid in knowing why this story is so hard to tell. There are so many possibilities with only one large canyon.

Wayne Ranney is a geologist, river and trail guide, and award winning science writer. He specializes in making complex scientific ideas more accessible and meaningful to non-specialists. His research interests include the landscape development and stratigraphy of the American Southwest, and developing ways to help the general public appreciate scientific thought. His books include "Carving Grand Canyon", "Sedona Through Time", and "Ancient Landscapes of the Colorado Plateau". He lives in Flagstaff, Arizona with his wife Helen.

UN Goal of Limiting Warming is Nearly Impossible, Researchers Say

by Eli Kintisch; 8 April 2011

International negotiators at a United Nations-sponsored climate conference ending today in Bangkok repeatedly underscored the goal of keeping the amount of global warming in this century to no more than 2˚C. But results from a Canadian

government climate modeling study published last month suggest that "it is unlikely that warming can be limited to the 2˚C target," the scientists who wrote the study say.

The paper finds that reaching that goal would require that greenhouse emissions "ramp down to zero immediately" and that scientists deploy means, starting in 2050, to actively remove greenhouse gases from the atmosphere. Previous modeling efforts have already highlighted the difficulty of reaching the 2˚C goal. But the new study is unique in several ways. Most important, it relies on the first published results from the latest generation of so-called Earth System climate models, complex programs that run on supercomputers and seek to simulate the planet's oceans, land, ice, and atmosphere. The model in this study, Canadian Earth System Model 2, also incorporates updated data on volcanic eruptions, and it simulates in a more sophisticated way the biosphere's ability to take in or emit carbon.

In the study, scientists with Environment Canada, a government agency, fed their model various scenarios of future greenhouse gas concentrations out to the year 2100. In the scenario with the most carbon emissions, the concentration of CO_2 in the atmosphere skyrocketed from its current level, about 390 parts per million, to 920 ppm, and global land surface temperature rose by 4.9˚C above 2005 levels. But even in a scenario in which emissions cuts caused CO_2 levels to peak at 450 ppm in 2050, temperatures rose by 2.3˚C by the end of the century, above the 2˚C goal.

In one figure in the paper, the highest-emissions pathway was depicted with an orange line, with the lowest-emissions line in blue. "In terms of emissions, right now we're more likely on the orange line than on the blue, " said co-author Ken Denman, an oceanographer at the University of Victoria in Canada who is affiliated with Environment Canada. Much higher temperatures may await humanity if emissions aren't reduced quickly, and the difficulty of reaching the 2˚C goal may be irrelevant, he says.

Climate modeler Myles Allen of the University of Oxford in the United Kingdom says that the paper's findings suggest a way to buy time while we reduce CO_2 emissions: cut emissions of short-lived gases that warm the atmosphere aggressively but persist in the atmosphere for decades instead of centuries, like CO_2. "I wouldn't see this as hopeless," he says. "Methane, for example, is relatively short-lived. We have time to invent the technologies required ... to deal with it, in contrast to CO_2."

As for the paper's conclusion that removing atmospheric carbon is necessary in order to achieve the 2˚C target, climate scientist Richard Moss of the Pacific Northwest National Laboratory's Joint Global Change Research Institute in College Park, Maryland, says that's a nearly impossible goal "with what we know about today." But later in the century, carbon-removing techniques, such as burning biofuels while capturing their carbon emissions or developing carbon-sucking machines, may be feasible.

"We can't give up" on emissions cuts, says Denman, although it's "probably already too late" to limit warming to 2˚C. "But maybe we'll have to live with 3 or 4 degrees of warming."

Ancient 'Hyperthermals' Serve as Guide to Anticipated Climate Changes; Sudden Global Warming Events More Frequent?

ScienceDaily — Bursts of intense global warming that have lasted tens of thousands of years have taken place more frequently throughout Earth's history than previously believe, according to evidence gathered by a team led by Scripps Institution of Oceanography, UC San Diego researchers.

Richard Norris in his lab with ancient sediments obtained by the Ocean Drilling Program reveal the mark of "hyperthermals," warming events lasting thousands of years that changed the composition of the sediment and its color. The dark color in the large sediment core sample at left depicts the onset and aftermath of a 55-million-year-old warming event when changes in ocean temperatures altered the composition of marine life (Credit: Scripps Institution of Oceanography, UC San Diego)

Richard Norris, a professor of geology at Scripps who co-authored the report, said that releases of carbon dioxide sequestered in the deep oceans were the most likely trigger of these ancient "hyperthermal" events. Most of the events raised average global temperatures between 2° and 3° Celsius (3.6 and 5.4° F), an amount comparable to current conservative estimates of how

much temperatures are expected to rise in coming decades as a consequence of anthropogenic global warming. Most hyperthermals lasted about 40,000 years before temperatures returned to normal.

The study appears in the March 17 issue of the journal *Nature*.

"These hyperthermals seem not to have been rare events," Norris said, "hence there are lots of ancient examples of global warming on a scale broadly like the expected future warming. We can use these events to examine the impact of global change on marine ecosystems, climate and ocean circulation."

The hyperthermals took place roughly every 400,000 years during a warm period of Earth history that prevailed some 50 million years ago. The strongest of them coincided with an event known as the Paleocene-Eocene Thermal Maximum, the transition between two geologic epochs in which global temperatures rose between 4° and 7° C (7.2° and 12.6° F) and needed 200,000 years to return to historical norms. The events stopped taking place around 40 million years ago, when the planet entered a cooling phase. No warming events of the magnitude of these hyperthermals have been detected in the geological record since then.

Phil Sexton, a former student of Norris' now at the Open University in the United Kingdom, led the analysis of sediment cores collected off the South American coast. In the cores, evidence of the warm periods presented itself in bands of gray sediment layered within otherwise pale greenish mud. The gray sediment contained increased amounts of clay left after the calcareous shells of microscopic organisms were dissolved on the sea floor. These clay-rich intervals are consistent with ocean acidification episodes that would have been triggered by large-scale releases of carbon dioxide. Large influxes of carbon dioxide change the chemistry of seawater by producing greater amounts of carbonic acid in the oceans.

The authors concluded that a release of carbon dioxide from the deep oceans was a more likely cause of the hyperthermals than other triggering events that have been hypothesized. The regularity of the hyperthermals and relatively warm ocean temperatures of the period makes them less likely to have been caused by events such as large melt-offs of methane hydrates, terrestrial burning of peat or even proposed cometary impacts. The hyperthermals could have been set in motion by a build-up of carbon dioxide in the deep oceans caused by slowing or stopping of circulation in ocean basins that prevented carbon dioxide release.

Norris noted that the hyperthermals provide historical perspective on what Earth will experience as it continues to warm from widespread use of fossil fuels, which has increased carbon dioxide concentrations in the atmosphere nearly 50 percent since the beginning of the Industrial Revolution. Hyperthermals can help scientists produce a range of estimates for how long it will take for temperatures to fully revert to historical norms depending on how much warming human activities cause.

"In 100 to 300 years, we could produce a signal on Earth that takes tens of thousands of years to equilibrate, judging from the geologic record," he said.

The scientists hope to better understand how fast the conditions that set off hyperthermals developed. Norris said that 50 million year old sediments in the North Sea are finely layered enough for scientists to distinguish decade-to-decade or even year-to-year changes.

Co-authors of the paper include researchers from the National Oceanography Centre Southampton at the University of Southampton in England and the Center for Marine Environmental Sciences, University of Bremen, Germany.

Journal Reference:

1. Philip F. Sexton, Richard D. Norris, Paul A. Wilson, Heiko Pälike, Thomas Westerhold, Ursula Röhl, Clara T. Bolton, Samantha Gibbs. **Eocene global warming events driven by ventilation of oceanic dissolved organic carbon**. *Nature*, 2011; 471 (7338): 349

"GEOLOGY OF THE LAKE TAHOE REGION, NEVADA and CALIFORNIA"

NCGS LAKE TAHOE FIELD TRIP

Saturday, June 25 and Sunday, June 26, 2011
Field Trip Leader:
Dr. Richard Schweickert, Professor Emeritus of Geology
University of Nevada, Reno

Dr. Richard Schweickert received his Ph.D. in Geology at Stanford University, and was an Associate Professor at Columbia University and then Professor of Geology at the University of Nevada, Reno until his retirement in January 2010. He was a Foundation Professor at the University since 1993. He specializes in research on structural geology and tectonics, with special emphasis on the Sierra Nevada and the western U.S. With NSF funding, he has carried out research in Alaska, California, Nevada, Chile, Argentina, Newfoundland, Italy, and Corsica. His ongoing research includes: active faults, landslides, and tsunamis in the Lake Tahoe basin involving detailed structural mapping, trenching, drilling, submarine geology, soil gas profiling, and stratigraphic studies; volcanic stratigraphy of the Lake Tahoe basin; stratigraphy, structure, and geologic history of the Tahoe City area; and structure and stratigraphy of the Saddlebag Lake pendant and adjacent areas in the High Sierra.

Field Trip Synopsis: The Lake Tahoe basin is an active half-graben at the Sierra Nevada-Great Basin boundary. The basin was dammed near its present outlet by basaltic shield volcanoes about 2 Ma and ~900 Ka. Three main active fault zones lie within the basin and are capable of M7 earthquakes. Such earthquakes would likely generate significant tsunamis. A mega-landslide along the western edge of the lake removed latest Pleistocene glacial moraines, produced a ~10 km^3 debris avalanche, and generated a tsunami at least 30m high. Giant boulder mega-ripples were produced on shallow shelves north and south of the mega-landslide. The age of the mega-landslide is uncertain, but likely is between 15 Ka and 7 Ka. This fieldtrip will feature stops at South Lake Tahoe, Emerald Bay, Meeks Bay, Sugar Pine Point, Eagle Rock, Tahoe City, and Kings Beach. Evidence of active faults, landslides, glaciation, basaltic volcanism, and tsunamis will be emphasized.

********** **Field Trip Logistics** **********

For details and a registration form please go to the NCGS website:
http://www.ncgeolsoc.org/FieldTripInfo/Lake%20Tahoe%20FT%20Flyer.pdf.

Please contact **Tridib Guha** with unanswered questions at: tridibguha@sbcglobal.net Phone: (925) 370-0685 (evening), (925) 451-1999 (day)

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NCGS DINNER MEETING

"Assembling California: an Update"

Also

"The initiative on recognition of Earth Science for entrance into the University: an Update"

Wednesday May 25, 2011

Speaker: Dr. Elridge M. Moores, Distinguished Professor Emeritus
University of California, Davis
6:00 PM at Orinda Masonic Center
(Reservations are required by May 21, 2011, 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. Elridge Moores**. 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: Assembling California: an Update

During the plate tectonic revolution in the 1960's, at first California geology played a small role. That changed with the December, 1969 Asilomar Penrose Conference, in which the Franciscan complex became the type example of a subduction complex, and the Sierra Nevada became a prime example of an Andean-style continental margin. Ophiolite emplacement and collisions between oceanic island arcs and the continent also were invoked in 1970 to explain western U.S. tectonic development, but acceptance of these ideas proceeded more slowly.

In the past two decades, however, many new data and concepts have enriched the picture of northern California's tectonic development, especially since publication of John McPhee's *Assembling California (1993)*. North America probably rifted away some 650-750 million years ago from its former continuation currently present in eastern Australia-East Antarctica. The oldest rocks in northern California--Shoo Fly-Antelope sediments, and the Trinity ophiolite--may have originated from the Appalachians/west Africa and Iapetus Ocean, respectively. Plate tectonic activity in the past 200 million years included collision of Pacific-derived island archipelagoes with North America, as well as subduction of several plates beneath the continental margin. An ophiolitic slab beneath the Great Valley tectonically overlies the continental edge of North America, resulting in a "double Moho" beneath the Valley. This feature has probably kept the Valley low as the Sierra and Coast Ranges rose around it.

Folds and thrusts in the northern Sierra Nevada may be as young as Cretaceous in age (Christe, 2010). At least one archipelago collision (Wrangellia) may be as young as 100 million years. The "Sevier-Laramide" orogeny may have resulted from mid-Cretaceous collision of a "ribbon continent" with North America (Johnston, 2008, Hildebrand, 2009) About 50 million years ago a Tibet-like highland (also called the "Nevadoplano": DeCelles, 2004) had developed in central-eastern Nevada, with a drainage divide in eastern Nevada (Henry et al, 2008). Major streams drained westward from this highland over deformed and eroded older Sierra rocks to the ocean in the present-day Sierra foothills. Deposits

include the Auriferous Gravels of the northern Sierra and younger silicic tuffs (Valley Spring formation) derived from large calderas in central Nevada. The San Andreas Fault system began some 29 million years ago. At present, the Sierra Nevada and Great Valley constitute the ***Sierra Microplate***, located between the Pacific and North American plates.

The long-term evolution of the North American Pacific margin encompasses complex processes of rifting, subduction, collision, igneous and metamorphic activity, and large-scale faulting of all types over some 650 million years. The western Pacific and Alpine orogens provide many insights into the nature of the tectonic development of the complex North American Pacific margin.

Speaker Biography:

Eldridge M. Moores is Distinguished Professor of Geology at the University of California, Davis. He was born and raised in the remote Arizona mining town of Crown King, where his father and grandfather operated small lead-zinc-gold mines. The Moores family was musically inclined, and Eldridge began to play the cello when he was thirteen, a passion he has enthusiastically pursued his entire life. He attended high school in Phoenix where he excelled in music and history. He majored in Geology at the California Institute of Technology and received his Bachelor's Degree in 1959. In 1963 he received a Ph.D. in Geology from Princeton University as a student of Professor Harry Hess. His post doctoral work at Princeton recognized the Troodos ophiolite complex on the Mediterranean island of Cyprus as ancient oceanic crust.

Eldridge came to U.C. Davis in 1966, and was Department Chair during the early 1970's. He continued his plate tectonic research, focusing on the tectonic evolution of Northern California and the Western U.S., and on the tectonics of the Alps, the Himalayas, Pakistan, Greece, and Cyprus. Eldridge has also made significant contributions to the plate tectonic evolution of Precambrian continental terranes and the associated bio-evolutionary effects. Dr. Moores has published extensively on Northern California tectonics, orogenies in the western United States, the evolution of the California Coast Range, processes of ophiolite emplacement, and on spreading center tectonics and ocean ridge ore deposition. He was President of the Geological Society of America in 1996, and editor of Geology magazine from 1981 to 1987. Eldridge received the GSA Distinguished Services Award in 1988 and the GSA Distinguished Career Award in 2006. He is a Fellow of the Geological Society of America, the California Academy of Sciences, and the American Association for the Advancement of Science, and an Honorary Fellow of the Geological Society of London. He received the Geological Association of Canada Medal in 1994 and was presented an Honorary D.Sc. from the College of Wooster in 1997. In 2003 the U.C. Davis Academic Senate awarded him its Distinguished Scholarly Public Service Award.

Dr. Moores is also actively involved in promoting Earth Science education at the K-12, undergraduate, and graduate levels locally, in Yolo County, and in Sacramento. He is a member of the National Science Foundation and has served on several other academic advisory committees in the Federal government. Eldridge collaborated closely with author John McPhee on the book "Assembling California," one of five books on geology in the 1998 Pulitzer Prize winning series "Annals of the Former World." He has also co-authored two geology textbooks with U.C. Davis colleague Dr. Robert J. Twiss, ***Tectonics*** and ***Structural Geology***.

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

Meeting Details: Social Hour: 6:00 – 7:00 pm; Dinner: 7:00 – 8:00 pm **Presentation**: 8:00 – open
Time: May 25, 2011, 6:00 pm, Orinda Masonic Center 9 Altarinda Road, Orinda, CA. **Cost**: **$20/person**

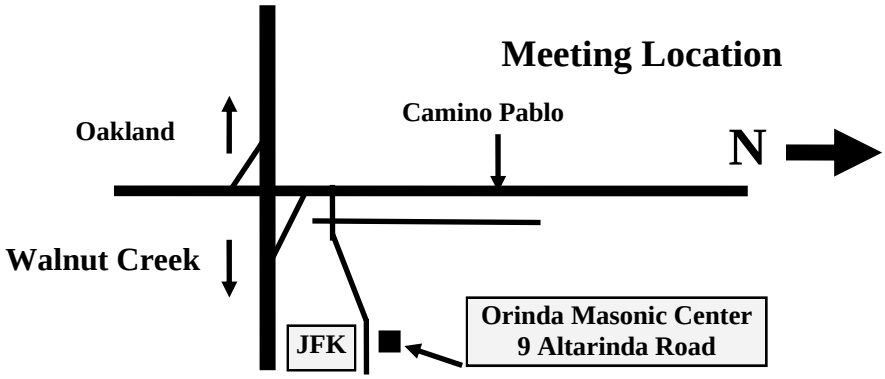
**********REGISTRATION FORM (Dr. Elridge Moores Dinner) **********

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@sbcglobal.net Phone: (925) 370-0685 (evening) (925) 451-1999 (day)



Biography, continued:

Dr. Tadeusz W. Patzek is a professor and chair of the Department of Petroleum and Geosystems Engineering at the University of Texas at Austin.

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.