NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

MEETING ANNOUNCEMENT

DATE: **September 29, 2010**

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. Stephen Testa, Executive Officer, California State Mining & Geology Board**

Geological Development in the Post-Gold Rush Era and the Fate of the First California Geological Survey

Geological development during the latter half of the 19th Century can be discussed from the perspectives of two men: Josiah D. Whitney and William P. Blake. These two influential geologists shared common social and educational backgrounds, and pursued similar professional career paths at a time when employment in geology was undependable. Their professional paths crossed numerous times over the course of five decades in what initially was an amicable personal and professional relationship that by 1860, evolved into competition for the position of State Geologist and Director of the first California Geological Survey, and California Commissioner for the London International Exhibition. Beyond simple competition, Whitney and Blake disagreed over important mainstream geological and ethnological issues germane to California during the latter half of the nineteenth century. The primary issues evolved around the potential economic value of oil and the Bodie Mining District, earthquakes and seismic risk, origin of the Yosemite Valley, the significance of the Calaveras Skull and the antiquity of man, the age of the gold-bearing rocks of California, and formation of the College of California. Both men were influential, however, Blake's contributions to the early geologic understanding of California were more optimistic and compatible with California's needs, while correctly forecasting the state's potential growth and providing insight into the geology and mineral and agricultural resources of the region. Despite Whitney's contributions while serving as director, his personal disposition and pessimistic views sealed the fate of the first geological survey of California.

Biography: **Stephen M. Testa** was appointed Executive Officer of the California State Mining and Geology Board in August 2005. From 1976 until August 2005, he served as an engineering geology and environmental

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NCGS 2010 – 2011 Calendar

Wednesday October 27, 2010
Dr. Geoffrey W. Marcy; Professor of Astronomy, University of California, Berkeley (Tentative)
TBA
7:00 pm at Orinda Masonic Lodge

Wednesday November 17, 2010 (Early Date!)
TBA
7:00 pm at Orinda Masonic Lodge

Wednesday January 26, 2011
TBA
7:00 pm at Orinda Masonic Lodge

Wednesday February 23, 2011
TBA
7:00 pm at Orinda Masonic Lodge

Wednesday March 30, 2011
TBA
7:00 pm at Orinda Masonic Lodge

Wednesday April 27, 2011
TBA
7:00 pm at Orinda Masonic Lodge

Upcoming NCGS Events

September 18, 2010	***Geology and Tectonics of the Smartville Complex, NW Sierra Nevada, California***; **Dr. Elridge Moores**, Distinguished Professor Emeritus, University of California, Davis **(Sorry - Full)**
October 16, 2010	A Teacher Workshop – NCGS Field Trip for the National Earth Science Week; ***A Walk Along the Old Bay Margin in Downtown San Francisco – Tracing the Events of the 1906 Earthquake & Fire***; **Dr. Raymond Sullivan**, Professor Emeritus, SFSU **(Sorry - Teachers Only)**
March / April 2011	Iron Mountain Mine Superfund Site, Redding, CA

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.

- No further meetings scheduled until the new academic year.

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:

- September 17, 2010 (Field Trip): The San Francisco – Oakland Bay Bridge Safety Project
- September 20 – 25; 2010 Annual Meeting; Charleston, SC

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/

- None currently posted

Notice of Implementation of New Payment Policy

At a recent Board meeting the NCGS Board adopted a new policy that will be effective this new academic year (September 2010 to June 2011). In an announcement in the June 2010 newsletter, comments were requested before any changes were to be implemented (to have been directed to **President Mark Sorensen**).

For members who receive our newsletter by regular mail, the Board has reluctantly adopted a new newsletter delivery policy. Printing and mailing each newsletter generally costs the Society $2.20 to $2.75, depending on the number of pages (and thus weight). With nine newsletters a year, total newsletter costs per mail newsletter recipient (alone) range between $19.80 and $24.75; clearly a money losing proposition. Regrettably, when society insurance (event and officer), meeting hall rental costs, and other administrative costs (website costs and etc.) are factored in, members who receive the newsletter by U.S.P.O. (snail) mail delivery are more heavily subsidized than these numbers suggest. **Consequently a $10 Snail Mail Surcharge has been approved by the NCGS Board**.

To save funds in this economic period, please consider converting to electronic delivery; it really prints just the same! Additional benefits are the fact that the newsletter is increasingly using color photos that are not as easily viewed in a black and white copy; and direct and fast access to web links that are now a standard feature in the newsletter. However, for diehard fans of hardcopy newsletter delivery, please sign up at the slightly increased rate of $25 per year. If you're a member of several societies, you know that it's still a bargain at that rate. And please note, with very rare exceptions with other societies, NCGS does not share email addresses. Thanks.

Modest Update on the BGG

You will recall that Tom Berry (NCGS Programs Chair and former Board of Geology and Geophysicists (BGG) Examination Committee Member) reported last month that at the Board of Professional Engineers and Land Surveyors (BPELS) meeting in Sacramento on May 5th, the Board voted to establish a Geologists and Geophysicists Technical Advisory Committee (G&G TAC). Five geologists including Tom were appointed on an interim basis to the G&G TAC, which as of this date has not met. Tom has requested that a meeting be convened. Tom also reports that until that time several geologists including Tom have volunteered to be Subject Matter Experts (SME).

(Editor's Note: The October 16th Teacher's Day Event organized by NCGS for local instructors has received advertisement by The Bay Area Earth Science Institute (BAESI). While a number of our members are very aware of BAESI we thought it appropriate to include a bit of background for those aren't necessarily aware. NCGS supports K–12 educational programs, similar to BAESI, thus wants to inform members of this great local resource. Spread it around!)

The Bay Area Earth Science Institute

Serving Bay Area teachers and their students since 1990

A non-profit organization founded in 1990, BAESI is the Bay Area's only Earth science-specific professional development program for precollege teachers. Funded by the National Science Foundation, San José State University, Chevron, Intel, NASA, and other partners, BAESI promotes earth science, with its multi-disciplinary approach and relevance to everyday life, as a powerful tool for bringing science to all students. Over the past 20, years, BAESI has served more than 2,000 teachers of grades 4-12 while developing a strong and effective model for teacher enhancement. BAESI is directed by Ellen Metzger and Richard Sedlock of SJSU's Geology Department.

Key elements of the BAESI program

- **Summer and academic year workshops and field trips** are keyed to the California science standards and consist of about 50% science content and 50% classroom applications. BAESI participants receive instructional materials and may earn inexpensive academic credit (~ $44/unit). BAESI can customize workshops to meet district or school needs.
- **Community Partnerships**

  Government, academic, and corporate partners provide materials, site visits, guest lectures, and other contributions.

- **Newsletter and web site**

  Workshop opportunities are announced via an electronic newsletter and on our website. To receive the newsletter, send your request to ellen.metzger@sjsu.edu

Retired Chevron geologist Will Schweller in the field with teachers on a field trip to Mt. Diablo

Bay Area Earth Science Institute
Department of Geology, San José State University,
San José, CA 95192-0102; phone 408-924-5030
Visit the BAESI web site at www.baesi.org

California Geological Survey

Please join the CGS for a meeting of the

California Post-Earthquake Information Clearinghouse Meeting

When: Wednesday, September 22, 2010 10:00 a.m. – 2:00 p.m.

Where: Elihu Harris State Building, 1515 Clay St., Oakland, CA, 94601, Room 11

(http://www.buildings.dgs.ca.gov/ElihuMHarrisbuilding/default.htm)

In California, the State Emergency Plan directs the California Geological Survey (CGS) and the California Emergency Management Agency (CalEMA) to work with other state and federal agencies to establish a Clearinghouse to collect organize and provide post-earthquake scientific information, for the benefit of all. The CA Clearinghouse is a well established group that has served as a model for other state clearinghouses. However, due to the intervening 16 years since the last significant earthquake in California, many engineers, researchers, emergency managers and others in the earthquake community are not aware of the Clearinghouse's existence and purpose.

What information does your organization require or collect immediately post-earthquake? This meeting will provide information on what the Clearinghouse is, what information it can provide, the organizations involved, and its usefulness to the emergency management community during post-earthquake response. Learn more about the Clearinghouse and how you can participate by attending this meeting.

Information on the Clearinghouse may be found at its website: http://www.eqclearinghouse.org/ and also in **USGS Circular 1242**, "*The Plan to Coordinate NEHRP Post-Earthquake Investigations*":

http://geopubs.wr.usgs.gov/circular/c1242/c1242.pdf

To RSVP, please contact Anne Rosinski, Senior Engineering Geologist, California Geological Survey at: anne.rosinski@conservation.ca.gov or Marjorie Greene, Earthquake Engineering Research Institute at mgreene@eeri.org.

If you are not able to attend the upcoming meeting in Oakland, but are interested in participating in future meetings, have suggestions you want to share or want to join one of our sub-committees (Information and Technology; Overflight; Outreach), please let us know.

Draft Agenda (subject to change):

10:00 Welcome and Introductions – Update on Clearinghouse Management

10:15 The California Post-Earthquake Clearinghouse – What it is and what it isn't

10:40 Committee reports:

Overflight Committee - John Tinsley (USGS): Using a dirigible for post-earthquake over-flight activities

Outreach & Education Committee – New Clearinghouse Fact Sheet

11:20 Suggestions for locations to hold future Clearinghouse meetings

11:30 – 12:30 Lunch

12:30 The Great California ShakeOut

12:35 DISCUSSION: What's on your California Earthquake Clearinghouse wish list?

1:45 Set tentative date and location for next stakeholder's meeting

2:00 Adjourn

State rock controversy enters new phase

By Dan Walters
Wednesday, Aug. 18, 2010

Last month, this column revealed that legislation to remove serpentine as California's state rock was more than the symbolic gesture it appeared to be.

Sponsored by an organization with close financial ties to law firms that specialize in asbestos liability lawsuits, Senate Bill 624 flatly declares that "serpentine contains the deadly mineral chrysotile asbestos, a known carcinogen, exposure to which increases the risk of the cancer mesothelioma (and) California has the highest rate of mesothelioma deaths in the nation."

Those words could bolster lawsuits by those exposed to serpentine, but they also raised the hackles of geologists who said they were untrue. One form of asbestos can sometimes be found in serpentine, they said, but does not pose a cancer threat.

The bill's history also was questionable. When Sen. Gloria Romero, D-Los Angeles, brought SB 624 before the Senate, it pertained to composting. But a day after Senate passage, its contents were stripped out and replaced by the state rock provisions – a technique commonly used to slip bills under the radar.

A few geologists got wind of the drive to condemn serpentine. The intense opposition in geologic circles resulted in the July 9 column, which touched off an intense debate that gained national (New York Times) and international (BBC) media attention.

Geologists and asbestos victim advocates tossed verbal grenades at each other for several weeks. Earlier this month, Jon Christensen – an environmental historian who runs the Bill Lane Center for the American West and is writing a book about serpentine – convened a meeting of the warring factions.

"As this debate exploded on the Internet and in the media over the past month, the arguments about serpentine have become mostly about things other than the rock itself," said Christensen, adding, "We shouldn't be surprised. Symbols, such as a state rock, mean different things to different people. What has been surprising is how powerful this symbol is to many people, and how strongly people feel about serpentine as a symbol."

Christensen could not broker an agreement, but this week, with the bill awaiting a vote on the Assembly floor, Romero stripped out the language condemning serpentine as a cancer threat and left only these words: "It is the intent of the Legislature to remove serpentine as the state rock and lithologic emblem."

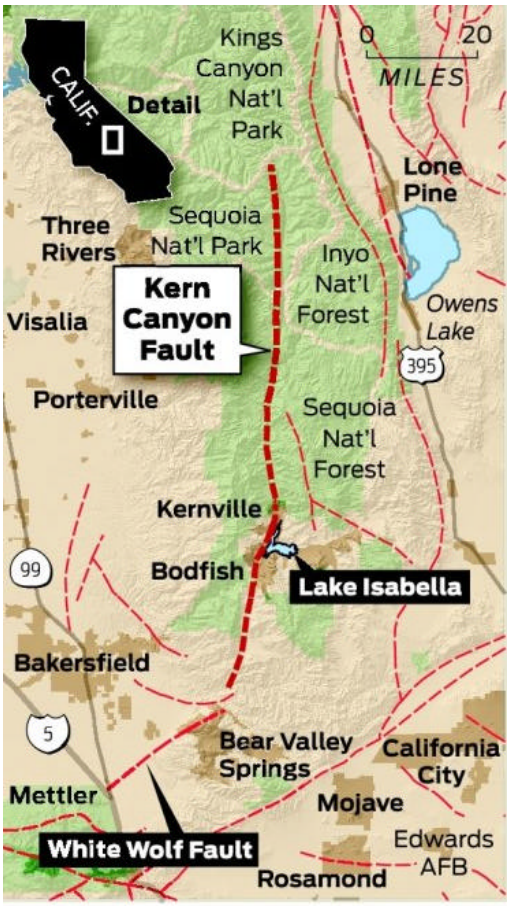
But that minimalist passage raises another question: Why?

Serpentine is found almost nowhere else but California. It is renowned for its color, which makes it a logical state rock if, indeed, California needs a state rock. If it's the "intent of the Legislature" to remove it, what's the rationale for doing so?

It would appear that Romero is trying to save face. She got herself involved in something unseemly and is trying to avoid a complete retreat by dropping the bill.

Inactive fault may trigger big quake after all

David Perlman, Chronicle Science Editor



Source: ESRI John Blanchard / The Chronicle

Kern Canyon Fault

A seismic fault in the Sierra Nevada, believed to have been quiet for more than 3 million years, is active after all and capable of triggering strong quakes with magnitudes of 6 or even 7, scientists say.

The Kern Canyon Fault, stretching for nearly 90 miles from north to south above the San Joaquin Valley east of Bakersfield, cuts beneath a major flood control dam on the Kern River.

For a half-dozen years those who oversee the 57-year-old Isabella flood control dam above Bakersfield, as well as California Institute of Technology geologists, have been studying the fault closely.

"It came as a surprise to see that a long-inactive fault can produce significant quakes," said geologist Elisabeth Nadin of Caltech, who has hiked the sparsely populated rugged terrain and mapped where evidence showed the fault ruptured violently at least 3,300 years ago.

Geologists working for the Army Corps of Engineers have also studied the fault's potential for rupturing and are surveying the dam to determine whether it needs strengthening against future large quakes.

The fault emerged some 86 million years ago when the immense granite mass of the Sierra was uplifting, said Nadin, who has found the evidence of past violence in the rocks around it.

For millions of years, the mountains around the fault rose and subsided again. Volcanic activity continued, and a pulse of volcanism about 3.5 million years ago left a lava flow at the fault's northern end, she said. Nadin said, "Seismic activity on the fault continues today."

Nadin, who just received her doctorate from Caltech, and her former Caltech adviser, Jason B. Saleeby who has also studied the fault, are publishing results of their findings in the September issue of the Bulletin of the Geological Society of America.

Typical of the evidence for recent temblors that Nadin cited are a series of "fault scarps" - small jagged cliffs 6 feet or more high - that run along the west side of the fault and indicate where the land was abruptly lifted up by the force of a quake. Those scarps, she said, show little evidence of erosion - a sign that they were uplifted relatively recently.

During her field explorations along the fault, Nadin said, she also found scores of rounded boulders - deposits from a period of intense glaciation some 12,000 years ago - that had been lifted up from deep beneath the surface by much more recent earthquake activity.

Ronn S. Rose, the dam safety program manager for the Army Engineers in Sacramento, and Keith I. Kelson, senior geologist at the earthquake consulting firm of Fugro William Lettis & Associates in Walnut Creek, are among a group of specialists surveying the fault because of potential hazard to the dam.

They have also studied evidence of recent seismic slip along the fault with a series of six deep trenches, isotope studies and drilling to reveal the ages of past quakes there.

Rose, Kelson and other geologists working for the Corps of Engineers said in a recent report that their evidence suggests that the Kern Canyon Fault could generate earthquakes with magnitudes "from 6.5 to perhaps 7.5."

Kelson said in an interview that the two-unit dam is considered a "critical facility" because the fault runs directly beneath one abutment of the dam's auxiliary unit.

"It would likely cost hundreds of millions of dollars to replace it in the event of complete failure," he said.

Although there is good evidence to determine the "slip rate" of recent movement along the fault, Rose said, it appears to be moving far more slowly than the annual slip rate along the San Andreas Fault - "a hundred times slower," he said in an interview.

The Isabella dam was built in 1953, primarily for flood control along the Kern River and to provide irrigation water for major Kern County farms around Bakersfield.

In her study, Nadin noted that many active faults lie in the region, notably the Garlock and White Wolf faults.

Whether those two have links deep underground to the Kern Canyon Fault is unknown, she said. The White Wolf Fault is considered potentially dangerous today because it ruptured violently in 1952 with a magnitude 7.3 quake that killed 12 in the tiny town of Tehachapi.

Journal Reference:

Elisabeth S. Nadin and Jason B. Saleeby, ***Quaternary reactivation of the Kern Canyon fault system, southern Sierra Nevada, California***, GSA Bulletin, May 2010, v. 122 no. 9-10 p. 1671-1685

Breakthrough Achieved in Explaining Why Tectonic Plates Move the Way They Do

ScienceDaily (July 17, 2010) — A team of researchers including Scripps Institution of Oceanography, UC San Diego geophysicist Dave Stegman has developed a new theory to explain the global motions of tectonic plates on the earth's surface.

The new theory extends the theory of plate tectonics -- a kinematic description of plate motion without reference to the forces behind it -- with a dynamical theory that provides a physical explanation for both the motions of tectonic plates as well as motion of plate boundaries. The new findings have implications for how scientists understand the geological evolution of Earth, and in particular, the tectonic evolution of western North America, in the past 50 million years.

The research, led by Monash University's Wouter Schellart, is published in the July 16 issue of the journal *Science*.

These findings provide a new explanation as to why tectonic plates move along the Earth's surface at the speeds that are observed, the details of which were previously not well-understood.

"The earth's surface is covered with tectonic plates that move with respect to one another at centimeters per year," Schellart said. "These plates converge at deep-sea trenches, plate boundaries where one plate sinks (subducts) below the other at so-called subduction zones. The velocities of these plates and the velocities of the boundaries between these plates vary significantly on Earth."

Schellart and his team, including Stegman and Rebecca Farrington, Justin Freeman and Louis Moresi from Monash University, used observational data and advanced computer models to develop a new mathematical scaling theory, which demonstrates that the velocities of the plates and the plate boundaries depend on the size of subduction zones and the presence of subduction zone edges.

"The scalings for how subducted plates sink in the earth's mantle are based on essentially the same fluid dynamics that describe how a penny sinks through a jar of honey," said Stegman, who developed the computer models that helped the team reenact tens of millions of years of tectonic movement. "The computer models demonstrate that the subducted portion of a tectonic plate pulls on the portion of the plate that remains on the earth's surface. This pull results in either the motion of the plate, or the motion of the plate boundary, with the size of the subduction zone determining how much of each."

"In some ways, plate tectonics is the surface expression of dynamics in the earth's interior but now we understand the plates themselves are controlling the process more than the mantle underneath. It means Earth is really more of a top-down system than the predominantly held view that plate motion is being driven from the bottom-up."

This discovery explains why the Australian, Nazca and Pacific plates move up to four times faster than the smaller African, Eurasian and Juan de Fuca plates.

"It also provides explanations for the motions of the ancient Farallon plate that sank into the mantle below North and South America. This plate slowed down during eastward motion from about 10 centimeters (four inches) per year some 50 million years ago to only 2 centimeters (0.8 inches) per year at present," Schellart said.

The decrease in plate velocity resulted from the decrease in subduction zone size, which decreased from 14,000 kilometers (8,700 miles) to only 1,400 kilometers (870 miles).

"This had a dramatic effect on the topography and the structure of the North American continent," said Schellart. "Until 50 million years ago, the west coast of North America was characterized by a massive mountain chain similar to the present day Andes in South America, and ran from Canada in the north to southern Mexico in the south."

As the subduction zone decreased in size, the compressive stresses along the west coast of North America decreased, resulting in destruction of the mountain range and formation of the Basin and Range province, a 2 million-square-kilometer (772,000-square-mile) area of elongated basins and ridges that characterizes the present-day western North American landscape.

Journal Reference:

W. P. Schellart, D. R. Stegman, R. J. Farrington, J. Freeman, and L. Moresi. **Cenozoic Tectonics of Western North America Controlled by Evolving Width of Farallon Slab**. *Science*, 16 July 2010: Vol. 329. no. 5989, pp. 316 - 319

Scientists: Newly found fault caused Haiti quake

By RICK CALLAHAN, Associated Press Writer, SF Chronicle, Saturday, August 14, 2010

The devastating earthquake that rocked Haiti in January was unleashed by a previously undetected fault line — not the well-known one scientists initially blamed, according to an analysis of new data.

It's unclear how dangerous the new, unmapped fault might be or how its discovery changes the overall earthquake hazard risk for Haiti, said Eric Calais, a professor of geophysics at Purdue University in West Lafayette, Ind.

He said the analysis shows that most, if not all, of the geologic movement that caused January's magnitude-7.0 earthquake occurred along the newly uncovered fault, not the well-documented Enriquillo fault.

Calais, who presented the findings this week at a scientific conference in Brazil, said they suggest Haiti's seismic zone is far more complex than scientists had anticipated. But the new fault's profile, including the possibility that it merges with the Enriquillo fault at some depth, won't be known until scientists intensively study the region.

"If there are other faults capable of producing earthquakes besides the Enriquillo and this new one we need to know about them. We need to go after them," he said from Brazil by telephone.

Calais said that at the time of the quake, Haiti had no seismic stations. Researchers who flocked to the Caribbean nation have since installed about 10 stations to monitor the earth's movement.

Ross Stein, a geophysicist with the U.S. Geological Survey in Menlo Park, Calif., said Calais' findings were fascinating and raise many questions about the complexity of Haiti's faults and what actually occurred during January's quake. But he said the discovery is not surprising, given the many unknowns about earthquakes.

Stein noted that even in California, whose many faults have been closely studied, about half of all moderate or stronger quakes occur on previously unknown faults.

"I work in a humbling field where we're constantly reminded of the depths of our ignorance," he said. "And if that's the case in California, then perhaps we shouldn't be surprised it also occurs to us in Haiti — a country that has barely been scoured at all."

The discovery is the sort of revelation that often comes after big earthquakes, when scientists descend on quake-ravaged sites to conduct intensive research, USGS geophysicist Bruce Presgrave said, adding "it's part of the learning process of science."

Earthquakes typically occur along fault lines, areas where two sections of the Earth's crust grind past each other. When decades or centuries of accumulated stress become too great at a fault boundary, the land gives way, causing an earthquake.

The first sign that the Enriquillo fault might not be to blame in the Haiti quake came when geologists didn't find any surface disturbance along the east-west fault. Instead, data pointed to new, unknown fault because an area north of the Enriquillo fault had been forced upward and to the south, Calais said.

The new findings are based on surface observations in the devastated region around Port-au-Prince, global positioning system measurements and other observations and data. Calais presented the research Tuesday at a meeting of the American Geophysical Union in Foz do Iguacu, Brazil.

In 2008, he warned that growing stresses in southern Haiti had left the Enriquillo fault ripe for up to a magnitude 7.2 quake. He said this week that the information then wasn't conclusive enough to say whether those stresses were building up along the Enriquillo fault, or some other fault.

Clovis Mammoth Hunters: Out With a Whimper or a Bang?

ScienceDaily (Apr. 12, 2010) — A team of researchers from the University of Arizona has revisited evidence pointing to a cataclysmic event thought by many scientists to have wiped out the North American megafauna -- such as mammoths, saber tooth cats, giant ground sloths and Dire wolves -- along with the Clovis hunter-gatherer culture some 13,000 years ago.

The team obtained their findings following an unusual, multidisciplinary approach and published them in the *Proceedings of the National Academy of Sciences* (PNAS).

"The idea of an extraterrestrial impact driving the Pleistocene extinction event has recently caused a stir in the scientific community," said C. Vance Haynes, a professor emeritus at UA's School of Anthropology and the department of geosciences,

who is the study's lead author. "We systematically revisited the evidence for an impact scenario and discovered it just does not hold up."

Haynes has dedicated his scientific career to the study of the Clovis people -- the first well-defined culture in the New World -- and discovered many sites with evidence of their presence in Arizona. One of the most prominent and most studied of those sites is the Murray Springs Clovis site in southeastern Arizona, where archaeologists and anthropologists have unearthed hundreds of artifacts such as arrowheads, spear points and stone tools. The site includes the remains of a Clovis hunters' camp close to a mammoth and a bison kill site, allowing the researchers to reconstruct the daily life of the Clovis culture to a certain extent.

Skeletal remains of mammoth, horse, camel, Dire wolf, and others tell of the megafauna that roamed southern Arizona during the Pleistocene Epoch until these large animals became extinct 13,000 years ago. The time of extinction coincides with the deposition of a black algal mat, visible as a black line just above the mammoth tooth in this photo, of Younger Dryas age, when hunter-gatherers of the Clovis culture inhabited the area. No remains of Pleistocene mammals have ever been found in sediments deposited above, and thus younger than, the black layer. UA scientists unearthed the fossil pictured here southeast of the Murray Springs Clovis site, where they sampled the black algal layer to test the hypothesis of cosmic impact as the cause of extinction and Younger Dryas cooling. (Credit: Photo courtesy of the Center for the Study of the First Americans)

When the last ice age came to an end approximately 13,000 years ago and the glaciers covering a large portion of the North American continent began melting and retreating toward the north, a sudden cooling period known as the "Big Freeze" or, more scientifically, the Younger Dryas, reversed the warming process and caused glaciers to expand again. Even though this cooling period lasted only for 1,300 years, a blink of an eye in geologic timeframes, it witnessed the disappearance of an entire fauna of large mammals.

The big question, according to Haynes, is 'Why did those animals go extinct in a very short geological timeframe?'"

"When you go out and look at the sediments deposited during that time, you see this black layer we call the Black Mat. It contains the fossilized remains of a massive algae bloom, indicating a short period of water table rise and cool climate that kept the moisture in the soil. Below the Black Mat, you find all kinds of fossils from mammoths, bison, mastodons, Dire wolves and so forth, but when you look right above it -- nothing."

Scientists have suggested several scenarios to account for the rapid Pleistocene extinction event. Some ascribe it to the rapid shift toward a cooler and dryer during the "Big Freeze," causing widespread droughts.

Haynes disagrees. "We find evidence of big changes in climate throughout the geologic record that were not associated with widespread extinctions."

Others have blamed the demise of the North American megafauna on pathogens brought onto the North American continent by animals from the Old World crossing the Bering Strait. "The disease hypothesis does not hold up well in the light of natural selection and evolution," Haynes said, "because some individuals would have been immune to the pathogens and survived."

The two attempts to account for the mass extinction event prevailing at this point include humans and celestial bodies. Many deem it possible that humans such as the Clovis culture hunted the Pleistocene mammals to extinction, as proposed by UA Professor Emeritus Paul S. Martin.

Alternatively, it is thought that a comet or asteroid slammed into the glaciers covering the Great Lakes area, unleashing firestorms that consumed large portions of vegetation. In addition, the dust and molten rock kicked up high into the atmosphere during the impact could have shrouded the Earth in a nuclear winter-like blanket of airborne dust, blocking sunlight and causing temperatures to plummet.

In the present study, Haynes and his coworkers set out to put the evidence for an impact scenario to the test: Unusually high concentrations of spherical magnetic particles in the soil samples taken at the Murray Springs Clovis site had been interpreted as indication of an extraterrestrial source.

Another hint in this direction was a spike in the Black Mat's iridium content -- an element rarely encountered on Earth but quite abundant in meteorites. In addition, the occurrence of nanodiamonds had been suggested as evidence of an extraterrestrial origin. Finally, a supposedly abundant charcoal content in the soil samples had been cited as evidence of widespread wildfires ravaging the land in the aftermath of the impact.

To ensure their samples were comparable, Haynes collected at the same locations in the Black Mat layer as the team proposing the impact scenario: "I sampled where they sampled and at the same times they sampled."

Using highly sensitive and sophisticated analytical methods, Haynes' coworkers at the department of geosciences and UA's Lunar and Planetary Lab then analyzed their samples for the evidence that had been presented in support of the impact scenario.

The team did find abundant magnetic spherules. But where did they come from? Was a meteorite the only possible source?

"Researchers have only begun to study those magnetic spherules recently, so we still don't know much about them," Haynes said. "What we do know is that they occur in exhaust from vehicles and power plants."

To determine whether the magnetic spherules found at Murray Springs could be of terrestrial origin, Haynes followed a tip from UA Geosciences Professor Anthony Jull, who suggested taking a sample of dirt from the rooftop of his house and examining it under the microscope.

Haynes remembers looking at the soil samples on a microscope slide, and "sure enough, there they were -- among all the dust and grains and grit, they appeared like tiny, shiny ball bearings."

"We did confirm the other authors' findings that the magnetic spherules are concentrated in the samples at the Clovis site, but when you study the topography on which the sediments were laid down, you immediately see why: Rainwater washed them down into a river bed, where they accumulated over time. Since this is where the samples with the increased spherule content came from, we were not surprised to find more of the spherules there. The samples we took from the slopes do not have higher than normal concentrations of spherules."

What about the charcoal indicating vegetation burning?

"The only places we found charcoal were the campsites of the Clovis people, where they build their fires."

But where could the nanodiamonds come from?

Again, Haynes' colleague, Anthony Jull, had the answer. A common ingredient of cosmic dust, nanodiamonds are constantly raining down onto the earth's surface, rendering them unsuitable as unequivocal evidence of an extraterrestrial impact.

"Something happened 13,000 years ago that we do not understand," said Haynes. "What we can say, though, is that all of the evidence put forth in support of the impact scenario can be sufficiently explained by earthly causes such as climate change, overhunting or a combination of both."

Does this mean the results obtained by Haynes and his coworkers rule out the possibility of a cosmic event?

"No, it doesn't," Haynes said. "It just doesn't make it very likely."

The co-authors of the study are: Jennifer Boerner (formerly at the UA's department of geosciences), Kenneth Domanik, Dante Lauretta and Julia Goreva from UA's Lunar and Planetary Laboratory in the department of planetary sciences and Jesse Ballenger in UA's School of Anthropology.

Journal Reference:

Haynes et al. **The Murray Springs Clovis site, Pleistocene extinction, and the question of extraterrestrial impact**. *Proceedings of the National Academy of Sciences*, 2010; 107 (9): 4010 DOI

Again as usual of late, the editor sincerely thanks John Christian for suggesting more than several of these articles for the newsletter! Please thank him for spotting some of these gems!

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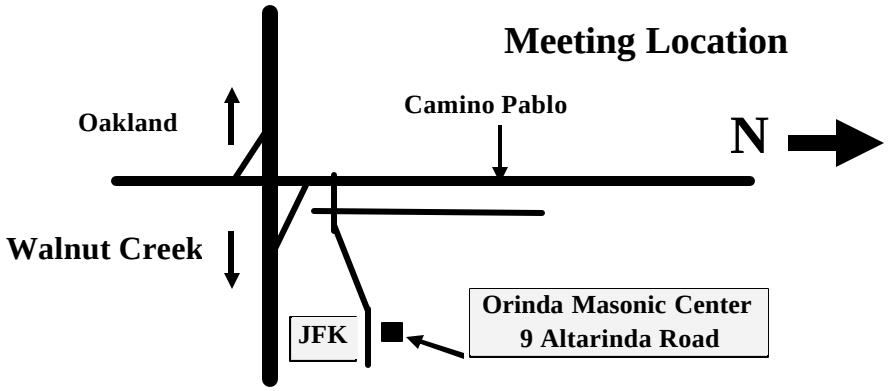

consultant for a variety of international firms including Bechtel, and Dames and Moore, and as CEO for Applied Environmental Services and Testa Environmental Corporation. A member of the Geological Society of America (Fellow), American Association of Petroleum Geologists, American Institute of Professional Geologists, Association of Engineering and Environmental Geologists and Society of Economic Geologists (Fellow), among others, Testa is the author of over 125 publications and several books including *One Man's Planet: Earth in Today's Political Culture, Geological Aspects of Hazardous Waste Management, The Reuse and Recycling of Contaminated Soils, and Restoration of Contaminated Aquifers: Petroleum Hydrocarbons and Organic Compounds*, and Petroleum in the Environment. He has served as an instructor at USC and CSU Fullerton. Testa is the Past-President of the American Geological Institute (AGI), the American Institute of Professional Geologists (AIPG) and the Los Angeles Basin Geological Society. Testa is past Editor-in-Chief of American Association of Petroleum Geologists – Division of Environmental Geosciences' (AAPG-DEG's) peer review journal "*Environmental Geosciences*", and the recipient of the AIPG's Martin Van Couvering Award and Honorary Membership, AAPG-DEG's Research Award, and the Roy Shlemon Geology Mentor Honorarium for excellence in application of applied earth science. Testa is a Registered Geologist and Certified Engineering Geologist in California, among other states.

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