NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

Website: www.ncgeolsoc.org

NCGS OFFICERS

President:
Phil Reed, Retired
philecreed@yahoo.com

President-Elect:
Vacant

Past President:
Tom Barry
tomasbarry@aol.com

Director Field Trips:
Tridib Guha, Consultant
tridibguha@yahoo.com

Treasurer:
Phil Reed, Retired
philecreed@yahoo.com

Program Director:
John Karachewski, Department of Toxic Substance Control
cageo@sbcglobal.net

Scholarship:
Phil Garbutt, Retired
plgarbutt@comcast.net

K-12 Programs:
Mark Petrofsky, Retired
mptrof@hotmail.com

Membership:
Rob Nelson, Clearwater Group, Inc.
rlngeology@sbcglobal.net

NCGS Newsletter & Website Editor:
Mark Detterman, Alameda County Environmental Health
mdetter1@gmail.com

Recording Secretary:
Dan Day, VA Engineering, Inc.
NCGS Voice Mail: 925-424-3669
danday94@pacbell.net

COUNSELORS

Don Lewis, Retired
donlewis@comcast.com

Ray Sullivan, Emeritus,
San Francisco State University
sullivan@lucasvalley.net

Barbara Matz, Shaw Group, Inc.
Barbara.Matz@shawgrp.com

Mark Sorensen, ITSI
Msorensen64@earthlink.net

MEETING ANNOUNCEMENT

DATE: **September 25, 2013**

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

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

SPEAKER: **Dr. William Motzer, PG, CHG**
Senior Geologist, Todd Engineers

Mercury Deposits of the California Coast Ranges and Their Environmental Impacts

Mercury (Hg) deposits occur at sites throughout California's Coast Ranges: e.g., *New Idria* (the largest producer), *New Almaden* (west of San Jose), and *Clear Lake* in the Mayacamas Mining District (the second largest). The major Hg ore is red *cinnabar* (mercury sulfide) although a black variety, *metacinnabar*, also occurs (see NCGS November 13, 2010 Field Trip Guidebook: *Geology of the Abandoned Mount Diablo Mine*). Ores were deposited from hydrothermal ("hot spring") activity, generally along active faults and associated extension fractures in Jurassic to Cretaceous [~200 to 100 million year old (Ma)] Franciscan complex host rocks. These were altered by the hot waters producing a *silica carbonate* rock, commonly having a "lighter" or bleached appearance. Hydrothermal activity is younger than the host rocks, ranging from Miocene (~23 Ma) to Pleistocene (~2.6 Ma). Ore deposits typically occur as masses, veins, and disseminations ranging from ≤1,300 to ≥600,000 tonnes, grading from ≤0.23 to ≥0.65% Hg.

Except for the Almaden Quicksilver Historic County Park and its historic trail, few old Hg mines are readily accessible. Prior to European discovery and mining, the New Almaden mercury deposits were used by the Ohlone Indians as a source of the deep red cinnabar for pigment and paint. It subsequently became a busy mining center for more than 125 years, from 1845 until 1976, with seven mines producing nearly 84 million pounds of valuable liquid Hg used for amalgamating fine placer and lode gold, Civil War explosives, Victorian glass, and 20th century battery cells and thermometers. Mine wastes however, have contaminated the Guadalupe River drainage and San Francisco Bay with elemental mercury being biologically converted to toxic mono-methylmercury.

…Continued on the back…

NCGS 2012 – 2013 Calendar

October 30, 2013
Dr. David A. Osleger, UC Davis
Paleo-precipitation records from Lake Tahoe cores

November 20, 2013
James J. Rytuba, Victoria E. Langenheim, and Daniel N. Goldstein, USGS, Menlo Park
Effects of the Paso Robles Geothermal System on water quality and availability in the Paso Robles Groundwater Basin, California

Upcoming NCGS Events

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@yahoo.com**.

Peninsula Geologic Society

Upcoming meetings

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

Bay Area Science

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/.

Garniss Curtis Memorial Update

The March newsletter contained an article about the passing of **Garniss Curtis**. Doris Sloan has provided us with a correction on the date of the memorial and a web link with further details. A celebration of Garniss Curtis' life will be held on Sept. 29, 2013, from 2 pm to 5 pm at the UC Berkeley Faculty Club. Details and RSVP instructions can be found at http://www.garnisscurtis.net.

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.

NCGS Support of the Bay Area Science Festival

One area of ongoing outreach that NCGS officers have supported is the K-12 Program. Recently NCGS officers have decided that the NCGS should participate at the Bay Area Science Festival on November 2nd at AT&T Park. Last year there were thirty thousand attendees, mainly youth, and their parents and teachers. The K-12 Committee has an initial set of ideas about what activities to set up, what information to disseminate, and what other things we want to do. We hope to focus on Bay Area landforms, rocks and minerals. If anyone has suggestions or is inspired to join the K-12 Committee in this work, please let us know.

We are asking for your help in setting up and / or staffing our 'booth' or station on Nov. 2nd. The main function will be to talk to people. This is actually the most important part of the exhibit effort and should be fun. Ideally we would like to have 4+ people present in shifts at all times. Set-up starts at 9:00 and the event goes from 11:00 to 4:00, so talk to us and let us know what time you can participate. More importantly, we welcome any ideas you have. When we decide on the final activities and presentations we will be contacting NCGS members for help with resources, especially local rock samples. Watch the newsletters, the NCGS website, and for emails.

You can learn more about the Festival at: www.bayareascience.org

If you have an interest in this endeavor contact: Mark Petrofsky 510 526-4944 mpetrof@holtmail.com and/or Paul Henshaw drphenshaw@comcast.net. This should be a fun event and an opportunity to talk to like interested folks, or folks who don't know this yet! Come join in the fun!

The Impacts of Impacts: Aspects of Catastrophic Climate and Ecological Changes by Asteroid Impacts (Part 1)

By NCGS Member ***Bill Motzer***

Reprinted from *The Vortex*, the newsletter of the California Section of the American Chemical Society (CALACS); (see www.calvaryslz.org/calacs/ for PDFs of the original articles and past issues of *The Vortex*)

As a geologist/geochemist, I have long been fascinated with the science of paleoclimatology. Scientists investigating past climates have backgrounds and expertise in geology, particularly in stratigraphy, paleontology (including micropaleontology and botany), petrology, hydrogeology, etc; but also in physics (including astrophysics and tectonophysics), chemistry (e.g., isotope geochemistry), and climatology. Paleoclimatologists scour the earth searching for rocks, minerals, and fossils that can reveal past climates. One paleoclimatologist has indicated that the study of paleoclimatology was like flying: "long periods of boredom accentuated by moments of stark terror!" It's those moments of "stark terror" that I'd like to discuss in this paper.

In 1980, the Nobel Prize physicist Luis Alvarez, his geologist son Walter, and chemists Frank Asaro and Helen Michels published their now famous paper in the journal Science (v. 208, no. 4448, pp. 1095–1108) about the discovery of an iridium (Ir)-rich clay layer separating the Cretaceous from the Tertiary (now renamed the Paleogene) Periods (~65.5 million years ago or (~65.5 Ma). Above this stratigraphic boundary, dinosaur fossils and approximately 70 to 75% of terrestrial and marine flora and fauna unique to the Cretaceous abruptly disappeared. As Dr. Alvarez stated: "…about half of all of the existing genera ceased to exist never to be seen again." (See also his very readable book: *T. rex and the Crater of Doom*: Vintage Books, New York, NY, 185 p.)

The "K-T" boundary is one of several extinction boundaries in the fossil record (another is the Permian-Triassic Extinction, for which I'll discuss it's geochemistry in a future article). What is unique about the K-T event is that for the first time, the Ir anomaly or fingerprint indicated that a large asteroid had impacted the Earth. This is because Ir is rather rare in terrestrial rocks (~0.03 ± 0.02 ng/g), but abundant in meteors and asteroids by a factor of 10^4. Based on the amount of Ir in the K-T clay layer, worldwide, Alvarez and his team estimated that the impacting asteroid was about 10 km in diameter (approximately the size of Mount Everest), that its approach velocity was ~25 km/s, and that it released an explosive energy equivalent to 10^8 Mt of TNT (1.0 Mt = 4.2×10^{15} J).

Without evidence of a K-T impact crater, their hypothesis caused considerable controversy among other scientists. There is fossil evidence that numerous dinosaur species and other biota were undergoing significant stress and declines prior to the K-T impact event; e.g., the Deccan Traps (a huge out pouring of basaltic lava also known as a *large igneous province* or LIP) in India that contributed large amounts of SO_2 (~1,000 Mt annually per 1,000 km of erupted lavas), CO_2, and Cl_2 to the atmosphere at least 300,000 years earlier and climate change has reported for other LIP eruptions that may be responsible for planet-wide extinctions (e.g., the Siberian Traps for the Permian extinction, occurring about 251 Ma). During the late Cretaceous, climate cooling was also occurring. Other hypotheses suggest that dinosaur's decline may have been from some type of insect-borne plague or other pathogen and recent fossil evidence tends to support this. In 1991, Alan Hildebrand and a team from the University of Arizona, Carson Services, Inc., Geological Survey of Canada, Petróleos Méxicanos, and Harvard University suggested that the ~180 – 200 km wide buried Chicxulub crater adjacent to the Yucatan peninsula, was the site of the K-T crater and the "smoking gun" as evidence of dinosaur extinction. The evidence for this crater was based on geological and gravity data, impact breccias, and shocked quartz, which are only found in impact structures and nuclear bomb detonation debris. Therefore, the current working hypothesis is that the K-T extinction was largely driven by the Chicxulub impact. (Note: this could have been a multiple impact event; we just haven't found the other craters.)

This has now become a serious subject: based on what we now know about past asteroid impacts, in 2005 Congress authorized NASA to catalog near-earth objects (NEOs) and their potential to impact the Earth. NEOs are defined as asteroids and comets with trajectories that bring them within 45×10^6 km of the Earth. Those NEOs greater than 140 m diameter that have orbits that bring them within 7.5×10^6 km of Earth's orbit have been classified as potentially hazardous objects (PHOs) and most of these are classified as potentially hazardous asteroids (PHAs)! NASA has cataloged 900 PHAs out of an estimated population of about 20,000 PHOs. Those >50 m could survive entry through the atmosphere and one impact may occur every 100 to 500 years. PHAs >1 km in diameter would cause global environmental disasters; these occur every few hundred thousand years to once every million years. PHAs ≥10 km (extinction-class) may occur on average every 50 to 100 million years. (And, the Chicxulub impact occurred 65.5 Ma!)

What would a Chicxulub-sized asteroid impact do to the Earth's climate and ecology and what could it do when it occurs again? In my next article, I'll briefly review some of the chemical and geochemical findings, including:

(1) Initial impact effects
(2) Tsunamis
(3) Thermal radiation and the resultant fires
(4) Impacts from injected atmospheric dust
(5) Sulfate aerosol effects
(6) Carbon dioxide inputs to the atmosphere
(7) Effects of heavy acid rain
(8) Metal poisoning of the environment

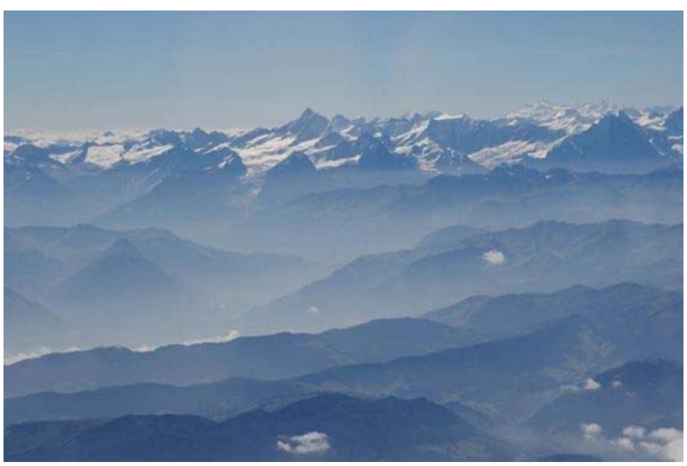
Industrial Soot Linked to the Abrupt Retreat of 19th Century Glaciers

A NASA-led team of scientists has uncovered strong evidence that soot from a rapidly industrializing Europe caused the abrupt retreat of mountain glaciers in the European Alps that began in the 1860s, a period often thought of as the end of the Little Ice Age.

The research, published Sept. 3 in the Proceedings of the National Academy of Sciences, may help resolve a longstanding scientific debate.

In the decades following the 1850s, Europe underwent an economic and atmospheric transformation spurred by industrialization. The use of coal to heat homes and power transportation and industry in Western Europe began in earnest, spewing huge quantities of black carbon and other dark particles into the atmosphere.

Black carbon is the strongest sunlight-absorbing atmospheric particle. When these particles settle on the snow blanketing glaciers, they darken the snow surface, speeding its melting and exposing the underlying glacier ice to sunlight and warmer spring and summer air earlier in the year. This diminishing of the snow cover earlier in each year causes the glacier ice to melt faster and retreat.



This photo from summer 2012 looking south into the Bernese Alps shows how air pollution in the Alps tends to be confined to lower altitudes, concentrating the deposition of soot and dust on the lower slopes. At center left in the picture, a glacier can be seen extending from a high-altitude snow field, above the pollution layer, down into the valley where its lower reach is bathed in pollutants. Image credit: Peter Holy More

The Little Ice Age, loosely defined as a cooler period between the 14th and 19th centuries, was marked by an expansion of mountain glaciers and a drop in temperatures in Europe of nearly 1.8 degrees Fahrenheit (1 degree Celsius). But glacier records show that between 1860 and 1930, while temperatures continued to drop, large valley glaciers in the Alps abruptly retreated by an average of nearly 0.6 mile (1 kilometer) to lengths not seen in the previous few hundred years. Glaciologists and climatologists have struggled to reconcile this apparent conflict between climate and glacier records.

"Something was missing from the equation," said Thomas Painter, a snow and ice scientist at NASA's Jet Propulsion Laboratory in Pasadena, Calif., who led the study. "Before now, most glaciologists believed the end of the Little Ice Age came in the mid-1800s when these glaciers retreated, and that the retreat was due to a natural climatic shift, distinct from the carbon dioxide-induced warming that came later in the 20th century. This result suggests that human influence on glaciers extends back to well before the industrial temperature increases."

To help the scientists understand what was driving the glacier retreat, Painter and his colleagues turned to history. The researchers studied data from ice cores drilled from high up on several European mountain glaciers to determine how much black carbon was in the atmosphere and snow when the Alps glaciers began to retreat. Using the levels of carbon particles trapped in the ice core layers, and taking into consideration modern observations of how pollutants are distributed in the Alps, they were able to estimate how much black carbon was deposited on glacial surfaces at lower elevations, where levels of black carbon tend to be highest.

The team then ran computer models of glacier behavior, starting with recorded weather conditions and adding the impact of the lower-elevation pollution. When this impact was included, the simulated glacier mass loss and timing finally were consistent with the historic record of glacial retreat, despite the cooling temperatures at that time.

"We must now look more closely at other regions on Earth, such as the Himalaya, to study the present-day impacts of black carbon on glaciers in these regions," said Georg Kaser, a study co-author from the University of Innsbruck, Austria, and lead author of the Working Group I Cryosphere chapter of the Intergovernmental Panel on Climate Change's upcoming Fifth Assessment Report.

"This study uncovers likely human fingerprints on our changing environment," said co-author Waleed Abdalati, director of the Cooperative Institute for Research and Environmental Sciences (CIRES) at the University of Colorado Boulder. "It's a reminder that the actions we take have far-reaching impacts on the environment in which we live."

Credits: Production editor: Dr. Tony Phillips; Photo Credit: Science@NASA

More information: CIRES is a joint institute of the university and the National Oceanic and Atmospheric Administration. Other institutions participating in the study include the University of Michigan - Ann Arbor and the University of California, Davis. The California Institute of Technology in Pasadena manages JPL for NASA.

Black Soot and Snow, A Warmer Combination -- a report from the Goddard Institute for Space Studies

Why an Ice Age Occurs Every 100,000 Years: Climate and Feedback Effects Explained

Science has struggled to explain fully why an ice age occurs every 100,000 years. As researchers now demonstrate based on a computer simulation, not only do variations in insolation play a key role, but also the mutual influence of glaciated continents and climate.

Glacier Perito Moreno National Park, Argentina Patagonia. (Credit: iStockphoto)

Ice ages and warm periods have alternated fairly regularly in Earth's history: Earth's climate cools roughly every 100,000 years, with vast areas of North America, Europe and Asia being buried under thick ice sheets. Eventually, the pendulum swings back: it gets warmer and the ice masses melt. While geologists and climate physicists found solid evidence of this 100,000-year cycle in glacial moraines, marine sediments and arctic ice, until now they were unable to find a plausible explanation for it.

Using computer simulations, a Japanese, Swiss and American team including Heinz Blatter, an emeritus professor of physical climatology at ETH Zurich, has now managed to demonstrate that the ice-age/warm-period interchange depends heavily on the alternating influence of continental ice sheets and climate.

"If an entire continent is covered in a layer of ice that is 2,000 to 3,000 metres thick, the topography is completely different," says Blatter, explaining this feedback effect. "This and the different albedo of glacial ice compared to ice-free earth lead to considerable changes in the surface temperature and the air circulation in the atmosphere." Moreover, large-scale glaciation also alters the sea level and therefore the ocean currents, which also affects the climate.

Weak effect with a strong impact

As the scientists from Tokyo University, ETH Zurich and Columbia University demonstrated in their paper published in the journal Nature, these feedback effects between Earth and the climate occur on top of other known mechanisms. It has long been clear that the climate is greatly influenced by insolation on long-term time scales. Because Earth's rotation and its orbit around the sun periodically change slightly, the insolation also varies. If you examine this variation in detail, different overlapping cycles of around 20,000, 40,000 and 100,000 years are recognisable.

Given the fact that the 100,000-year insolation cycle is comparatively weak, scientists could not easily explain the prominent 100,000-year-cycle of the ice ages with this information alone. With the aid of the feedback effects, however, this is now possible.

Simulating the ice and climate

The researchers obtained their results from a comprehensive computer model, where they combined an ice-sheet simulation with an existing climate model, which enabled them to calculate the glaciation of the northern hemisphere for the last 400,000 years. The model not only takes the astronomical parameter values, ground topography and the physical flow properties of glacial ice into account but also especially the climate and feedback effects. "It's the first time that the glaciation of the entire northern hemisphere has been simulated with a climate model that includes all the major aspects," says Blatter.

Using the model, the researchers were also able to explain why ice ages always begin slowly and end relatively quickly. The ice-age ice masses accumulate over tens of thousands of years and recede within the space of a few thousand years. Now we know why: it is not only the surface temperature and precipitation that determine whether an ice sheet grows or shrinks. Due to the aforementioned feedback effects, its fate also depends on its size. "The larger the ice sheet, the colder the climate has to be to preserve it," says Blatter. In the case of smaller continental ice sheets that are still forming, periods with a warmer climate are less likely to melt them. It is a different story with a large ice sheet that stretches into lower geographic latitudes: a comparatively brief warm spell of a few thousand years can be enough to cause an ice sheet to melt and herald the end of an ice age.

The Milankovitch cycles

The explanation for the cyclical alternation of ice and warm periods stems from Serbian mathematician Milutin Milankovitch (1879-1958), who calculated the changes in Earth's orbit and the resulting insolation on Earth, thus becoming the first to describe that the cyclical changes in insolation are the result of an overlapping of a whole series of cycles: the tilt of Earth's axis fluctuates by around two degrees in a 41,000-year cycle. Moreover, Earth's axis gyrates in a cycle of 26,000 years, much like a spinning top. Finally, Earth's elliptical orbit around the sun changes in a cycle of around 100,000 years in two respects: on the one hand, it changes from a weaker elliptical (circular) form into a stronger one. On the other hand, the axis of this ellipsis turns in the plane of Earth's orbit. The spinning of Earth's axis and the elliptical rotation of the axes cause the day on which Earth is closest to the sun (perihelion) to migrate through the calendar year in a cycle of around 20,000 years: currently, it is at the beginning of January; in around 10,000 years, however, it will be at the beginning of July.

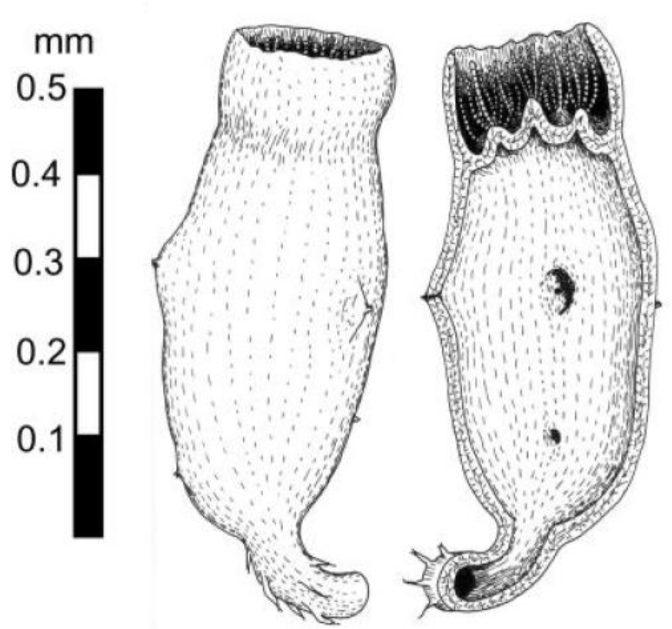
Based on his calculations, in 1941 Milankovitch postulated that insolation in the summer characterises the ice and warm periods at sixty-five degrees north, a theory that was rejected by the science community during his lifetime. From the 1970s, however, it gradually became clearer that it essentially coincides with the climate archives in marine sediments and ice cores. Nowadays, Milankovitch's theory is widely accepted. "Milankovitch's idea that insolation determines the ice ages was right in principle," says Blatter. "However, science soon recognised that additional feedback effects in the climate system were necessary to explain ice ages. We are now able to name and identify these effects accurately."

Story Source: The above story is based on materials provided by ETH Zurich. The original article was written by Fabio Bergamin.

Journal Reference: Ayako Abe-Ouchi, Fuyuki Saito, Kenji Kawamura, Maureen E. Raymo, Jun'ichi Okuno, Kunio Takahashi, Heinz Blatter. **Insolation-driven 100,000-year glacial cycles and hysteresis of ice-sheet volume**. *Nature*, 2013; 500 (7461): 190 DOI: 10.1038/nature12374

Greening of the Earth Pushed Way Back in Time

July 22, 2013 — Conventional scientific wisdom has it that plants and other creatures have only lived on land for about 500 million years, and that landscapes of the early Earth were as barren as Mars.



This is an interpretive view of Diskagma buttonii with exterior view, left, and cross section. The fossils are the size of match heads and were found connected into bunches by threads in the surface of an ancient soil from South Africa. (Credit: Courtesy of Gregory Retallack)

A new study, led by geologist Gregory J. Retallack of the University of Oregon, now has presented evidence for life on land that is four times as old -- at 2.2 billion years ago and almost half way back to the inception of the planet.

That evidence, which is detailed in the September issue of the journal *Precambrian Research*, involves fossils the size of match heads and connected into bunches by threads in the surface of an ancient soil from South Africa. They have been named Diskagma buttonii, meaning "disc-shaped fragments of Andy Button," but it is unsure what the fossils were, the authors say.

"They certainly were not plants or animals, but something rather more simple," said Retallack, professor of geological sciences and co-director of paleontological collections at the UO's Museum of Natural and Cultural History. The fossils, he added, most resemble modern soil organisms called Geosiphon, a fungus with a central cavity filled with symbiotic cyanobacteria.

"There is independent evidence for cyanobacteria, but not fungi, of the same geological age, and these new fossils set a new and earlier benchmark for the greening of the land," he said. "This gains added significance because fossil soils hosting the fossils have long been taken as evidence for a marked rise in the amount of oxygen in the atmosphere at about 2.4 billion to 2.2 billion years ago, widely called the Great Oxidation Event."

By modern standards, in which Earth's air is now 21 percent oxygen, this early rise was modest, to about 5 percent oxygen, but it represented a rise from vanishingly low oxygen levels earlier in geological time.

Demonstrating that Diskagma are fossils, Retallack said, was a technical triumph because they were too big to be completely seen in a standard microscopic slide and within rock that was too dark to see through in slabs. The samples were imaged using powerful X-rays of a cyclotron, a particle accelerator, at the Lawrence Berkeley National Laboratory in California.

The images enabled a three-dimensional restoration of the fossils' form: odd little hollow urn-shaped structures with a terminal cup and basal attachment tube. "At last we have an idea of what life on land looked like in the Precambrian," Retallack said. "Perhaps with this search image in mind, we can find more and different kinds of fossils in ancient soils."

In their conclusion, the researchers noted that their newly named fossil Diskagma is comparable in morphology and size to *Thucomyces lichenoides*, a fossil dating to 2.8 billion years ago and also found in South Africa, but its composition, including interior structure and trace elements, is significantly different.

Diskagma also holds some similarities to three living organisms, which were illustrated microscopically in the study: the slime mold *Leocarpus fragilis* as found in Oregon's Three Sisters Wilderness; the lichen *Cladonia ecmocyna* gathered near Fishtrap Lake in Montana; and the fungus *Geosiphon pyriformis* from near Darmstadt, Germany.

The new fossil, the authors concluded, is a promising candidate for the oldest known eukaryote --an organism with cells that contain complex structures, including a nucleus, within membranes.

"Researchers at the UO are collaborating with scientists from around the world to create new knowledge with far-reaching applications," said Kimberly Andrews Espy, UO vice president for research and innovation, and dean of the graduate school. "This research by Dr. Retallack and his team opens new doors of inquiry about the origins of ancient life on Earth."

Story Source: The above story is based on materials provided by University of Oregon.

Journal Reference: Gregory J. Retallack, Evelyn S. Krull, Glenn D. Thackray, Dula Parkinson. **Problematic urn-shaped fossils from a Paleoproterozoic (2.2Ga) paleosol in South Africa**. *Precambrian Research*, 2013; 235: 71 DOI: 10.1016/j.precamres.2013.05.015

Dawn of Carnivores Explains Animal Boom in Distant Past

A science team that includes researchers from Scripps Institution of Oceanography at UC San Diego has linked increasing oxygen levels and the rise and evolution of carnivores (meat eaters) as the force behind a broad explosion of animal species and body structures millions of years ago.

Nereids, carnivorous polychaete marine worms, utilize strong jaws to bite off chunks of soft-bodied animals. Authors of a new study in Proceedings of the National Academy of Sciences found that carnivorous polychaetes from low-oxygen regions decrease in abundance with decreasing oxygen levels. (Credit: Greg Rouse)

Led by Erik Sperling of Harvard University, the scientists analyzed how low oxygen zones in modern oceans limit the abundance and types of carnivores to help lead them to the cause of the "Cambrian radiation," a historic proliferation of animals 500-540 million years ago that resulted in the animal diversity seen today. The study is published in the July 29 early online edition of the *Proceedings of the National Academy of Sciences*.

Although the cause of the influx of oxygen remains a matter a scientific controversy, Sperling called the Cambrian radiation that followed "the most significant evolutionary event in the history of animals."

"During the Cambrian period essentially every major animal body plan -- from arthropods to mollusks to chordates, the phylum to which humans belong -- appeared in the fossil record," said Sperling, who is scheduled to join Scripps as a postdoctoral researcher through National Science Foundation support. The authors linked this proliferation of life to the evolution of carnivorous feeding modes, which require higher oxygen concentrations. Once oxygen increased, animals started consuming other animals, stimulating the Cambrian radiation through an escalatory predator-prey "arms race."

Lisa Levin, a professor of biological oceanography at Scripps, along with graduate student researcher Christina Frieder, contributed to the study by providing expertise on the fauna of the ocean's low-oxygen zones, areas that have been increasing in recent decades due to a variety of factors. While the Cambrian radiation exploded with new species and diversification, Levin believes this study suggests the reverse may ensue as oxygen declines and oxygen minimum zones expand.

"This paper uses modern oxygen gradients and their effects on marine worms to understand past evolutionary events" said Levin, director of Scripps's Center for Marine Biodiversity and Conservation and a 1982 Scripps graduate. "However, the study of oxygen's role in the past is also going to help us understand the effects of and manage for changes in ocean oxygen in the future."

As part of the research study, Sperling spent time at Scripps working with Levin and Frieder. He also participated in the San Diego Coastal Expedition (bit.ly/sdcoastex), a cruise led by Frieder aboard the Scripps/U.S. Navy research vessel *Melville* and funded by the UC Ship Funds program, which offers students unique access to at-sea training and research.

In addition to Sperling, Frieder, and Levin, coauthors of the paper include Akkur Raman of Andhra University (India) and Peter Girguis and Andrew Knoll of Harvard. Funding for the study was provided by Ministry of Earth Sciences, New Delhi, Agouron Geobiology, the National Science Foundation, and NASA.

Story Source: The above story is based on materials provided by University of California, San Diego. The original article was written by Mario Aguilera.

Journal Reference: E. A. Sperling, C. A. Frieder, A. V. Raman, P. R. Girguis, L. A. Levin, A. H. Knoll. **Oxygen, ecology, and the Cambrian radiation of animals**. *Proceedings of the National Academy of Sciences*, 2013; DOI: 10.1073/pnas.1312778110

Ancient Ice Melt Unearthed in Antarctic Mud: 20-Meter Sea Level Rise, Five Million Years Ago

Global warming five million years ago may have caused parts of Antarctica's large ice sheets to melt and sea levels to rise by approximately 20 metres, scientists report today in the journal *Nature Geoscience*.

The researchers, from Imperial College London, and their academic partners studied mud samples to learn about ancient melting of the East Antarctic ice sheet. They discovered that melting took place repeatedly between five and three million years ago, during a geological period called Pliocene Epoch, which may have caused sea levels to rise approximately ten meters.

Scientists have previously known that the ice sheets of West Antarctica and Greenland partially melted around the same time. The team say that this may have caused sea levels to rise by a total of 20 meters.

The academics say understanding this glacial melting during the Pliocene Epoch may give us insights into how sea levels could rise as a consequence of current global warming. This is because the Pliocene Epoch had carbon dioxide concentrations similar to now and global temperatures comparable to those predicted for the end of this century.

Dr Tina Van De Flierdt, co-author from the Department of Earth Science and Engineering at Imperial College London, says: "The Pliocene Epoch had temperatures that were two or three degrees higher than today and similar atmospheric carbon dioxide levels to today. Our study underlines that these conditions have led to a large loss of ice and significant rises in global sea level in the past. Scientists predict that global temperatures of a similar level may be reached by the end of this century, so it is very important for us to understand what the possible consequences might be."

The East Antarctic ice sheet is the largest ice mass on Earth, roughly the size of Australia. The ice sheet has fluctuated in size since its formation 34 million years ago, but scientists have previously assumed that it had stabilized around 14 million years ago.

The team in today's study were able to determine that the ice sheet had partially melted during this "stable" period by analyzing the chemical content of mud in sediments. These were drilled from depths of more than three kilometers below sea level off the coast of Antarctica.

Analyzing the mud revealed a chemical fingerprint that enabled the team to trace where it came from on the continent. They discovered that the mud originated from rocks that are currently hidden under the ice sheet. The only way that significant amounts of this mud could have been deposited as sediment in the sea would be if the ice sheet had retreated inland and eroded these rocks, say the team.

The academics suggest that the melting of the ice sheet may have been caused in part by the fact that some of it rests in basins below sea level. This puts the ice in direct contact with seawater and when the ocean warms, as it did during the Pliocene, the ice sheet becomes vulnerable to melting.

Carys Cook, co-author and research postgraduate from the Grantham Institute for Climate Change at Imperial, adds: "Scientists previously considered the East Antarctic ice sheet to be more stable than the much smaller ice sheets in West Antarctica and Greenland, even though very few studies of East Antarctic ice sheet have been carried out. Our work now shows that the East Antarctic ice sheet has been much more sensitive to climate change in the past than previously realised. This finding is important for our understanding of what may happen to the Earth if we do not tackle the effects of climate change."

The next step will see the team analysing sediment samples to determine how quickly the East Antarctic ice sheet melted during the Pliocene. This information could be useful in the future for predicting how quickly the ice sheet could melt as a result of global warming.

Story Source: The above story is based on materials provided by Imperial College London. The original article was written by Colin Smith.

Journal Reference: Carys P. Cook, Tina van de Flierdt, Trevor Williams, Sidney R. Hemming, Masao Iwai, Munemasa Kobayashi, Francisco J. Jimenez-Espejo, Carlota Escutia, Jhon Jairo González, Boo-Keun Khim, Robert M. McKay, Sandra Passchier, Steven M. Bohaty, Christina R. Riesselman, Lisa Tauxe, Saiko Sugisaki, Alberto Lopez Galindo, Molly O. Patterson, Francesca Sangiorgi, Elizabeth L. Pierce, Henk Brinkhuis, Adam Klaus, Annick Fehr, James A. P. Bendle, Peter K. Bijl, Stephanie A. Carr, Robert B. Dunbar, José Abel Flores, Travis G. Hayden, Kota Katsuki, Gee Soo Kong, Mutsumi Nakai, Matthew P. Olney, Stephen F. Pekar, Jörg Pross, Ursula Röhl, Toyosaburo Sakai, Prakash K. Shrivastava, Catherine E. Stickley, Shouting Tuo, Kevin Welsh, Masako Yamane. **Dynamic behaviour of the East Antarctic ice sheet during Pliocene warmth**. *Nature Geoscience*, 2013; DOI: 10.1038/ngeo1889

USGS Geologist Honored For Contributions To Better Understanding The Grand Canyon

A USGS geologist has been honored for his work that helps unlocks the mysteries how of the Grand Canyon gained its present form. Rebecca Latson photo.

A research geologist for the U.S. Geological Survey has been honored by the Geological Society of America for work that helps explain how and when the Grand Canyon and the lower Colorado River took their present form.

According to a USGS release, that scientific problem "has vexed geologists for more than a century. "

Kyle House is the lead author on a paper, ***Stratigraphic evidence for the role of lake spillover in the inception of the lower Colorado River in southern Nevada and western Arizona.*** His co-authors were Phil A. Pearthree and Michael E. Perkins. Their paper was recently announced as the GSA's 2013 recipient of the prestigious *Kirk Bryan Award for Research Excellence*.

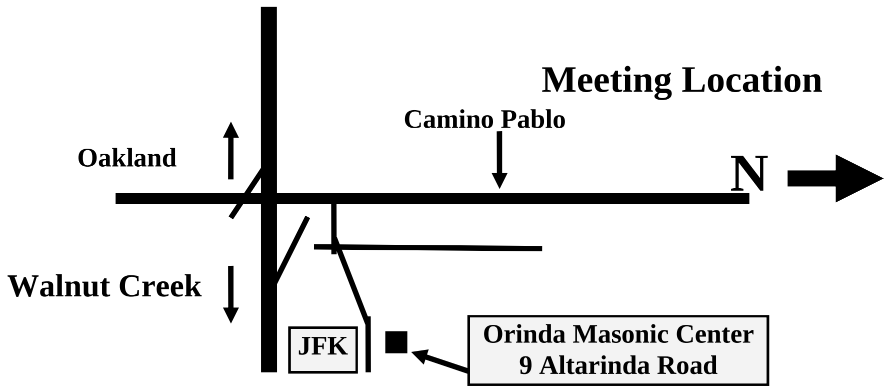
The paper, written while House was with the Nevada Bureau of Mines and Geology and supported in part by USGS, describes geologic evidence supporting a model of lake spillover as a primary mechanism in the origin of the course of the lower Colorado downstream of the Grand Canyon.

"By unraveling key details in the geologic record of the river's first arrival downstream from the canyon, House and his co-authors provided new and strong support for previous arguments for a 5- to 6-million-year age of the modern course of the lower Colorado River and presented evidence for a downstream river integration process involving a stair-stepping series of filling and spilling lakes," the USGS release said.

"The Colorado River has left geologists a with a long trail of clues to understanding the chain of events leading to its present course and form. Our mapping efforts demonstrate that many of these clues lie well beyond the Grand Canyon and into the low desert downstream," House said.

"Discovering, interpreting, and assembling those clues is the goal of geologic mapping and, in effect, the essence of geology. We are deeply honored to receive this award from the Geological Society of America in recognition of our carrying out fundamental geologic science in the interest of understanding one of the world's great rivers," he added.

This new evidence for the nature of the river's origin downstream from the Grand Canyon has revitalized interest in developing a more complete understanding of the complete geologic history of the lower Colorado River, and its linkage to climatic and geologic change. It has led to a new regional geologic mapping project being led by House and the USGS Geology, Minerals, Energy, and Geophysics Science Center that will focus on this iconic national resource.



Biography: **William E. (Bill) Motzer** holds a Ph.D. in Geology from the University of Idaho. He is a registered California Professional Geologist (PG) and Certified Hydrogeologist (CHG), with PG registrations in five other states. Bill has extensive experience in conducting surface and subsurface water quality chemistry and environmental forensic investigations. He formerly was a minerals exploration/mining geologist with projects from Alaska to Mexico that included the search for hot spring-type mercury/gold deposits. Bill is a recognized expert in forensic geochemistry, with particular expertise in stable and other isotopic "fingerprinting" and age dating techniques, water quality/contaminants, and emerging contaminant geochemistry. He has conducted more than 400 environmental projects, including mine litigation support, throughout California and other western states. He is a current NCGS member, past President of the San Francisco Bay Branch of the Groundwater Resources Association of California, and the current Northern California Section Chair for the Society for Mining, Metallurgy, & Exploration (SME).

You Can Believe It! – It's Time To Renew!

Please Use the Attached Renewal Form for the Current NCGS Year (September 2013 – August 2014)

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.

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

2013-2014 Renewal Form

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

Mail to:

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

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

Please provide the following information:

Name: ____

E-mail:____

☐ **Please do not show my contact information (email address, mailing address, phone numbers) on any published NCGS directory.**

I can help with:

Programs_____ Field Trips_____ Newsletter_____ Web Site_____

K-12 Programs_____ Scholarships_____ AAPG Delegate_____ Membership_____

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

Address ____

City, State, Zip____

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

Employer _________________________________Job Title__________