NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

MEETING ANNOUNCEMENT

DATE: **May 28, 2014**

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. Kevin Padian,** Professor and Curator, Department of Integrative Biology and Museum of Paleontology, University of California, Berkeley

WHY DON'T VERTIBRATES CARE ABOUT MASS EXTINCTIONS?

Reservations are required by May 23, 2013
Please Use Attached Form
We are sorry but we will not be able to accommodate "walk-ins"

Abstract:

We know that there have been five major mass extinctions in the history of life. The problem is, no one told the vertebrates. We don't have any serious evidence that terrestrial vertebrates have experienced heightened extinction rates during episodes when marine invertebrates have dropped in diversity. There is absolutely no convincing evidence for synchronicity between marine and terrestrial realms in these troubled times. But wait, it gets worse: we have no standard definition of mass extinction. So how do we know when a mass extinction has occurred? Worse than that, we don't differentiate between increases in extinction rate and drops in origination rates when it comes to changes in net diversity. So it's like not making a difference in going broke between losing your job and spending all your wages at the track. Is it any wonder we're so confused?

NCGS 2012 – 2013 Calendar

June 25, 2014
Jason Utas, PhD Candidate at UCLA
Meteorites

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/.

NCGS Board Meeting Announcement

The next NCGS Board meeting will be held on Saturday, May 17 at 8:30am to noon at the CBI office, 4005 Port Chicago Hwy, Suite 200, Concord, California 94520.

All NCGS members are invited to attend and to participate in the governance and committee work of the Society. Please come and enjoy the fun! If you are not already on the Board or one of its committees, please let **Phil Reed** (philecreed@yahoo.com) know of your planned attendance so we can arrange adequate donuts, bagels, and coffee.

Volcanic Violence

(Part 1)

*By NCGS Member **Dr. Bill Motzer***

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

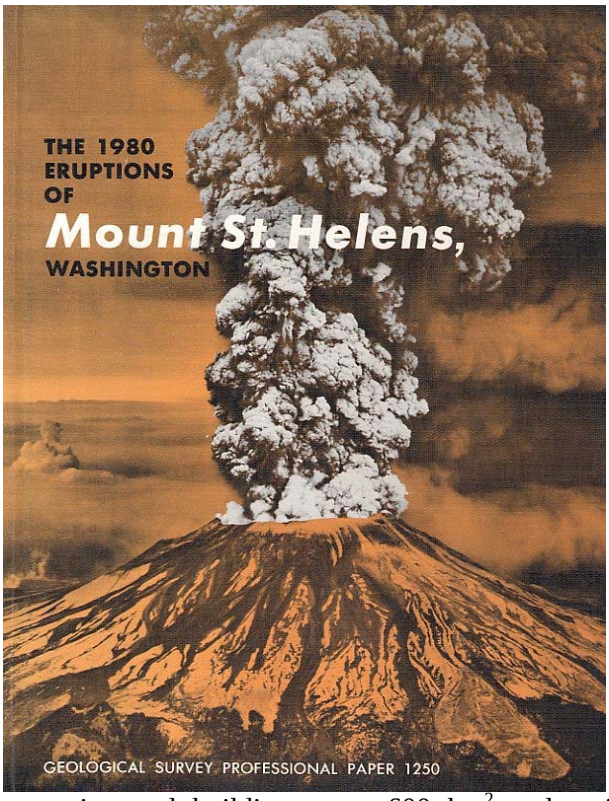
We all have an extraordinary ability to remember in detail significant events (e.g. 911, the Loma Prieta earthquake, etc.). Sunday, May 18th will mark the 34th anniversary of such an event – the eruption of Mount Saint Helens – the only volcanic eruptive episode that I have experienced on a scientific and personal level. On that day I was completing an instructorship at the University of Idaho in Moscow, Idaho, diligently grading final examinations for two geology courses that I had taught that semester. Mt. St. Helens had been become active several weeks before and most geology students and faculty were closely following news bulletins particularly those issued by the U.S. Geological Survey's volcanic observatory on Mt. St. Helens.

One of my fellow graduate students, Jim Fitzgerald, was completing his dissertation in volcanic geology; he had been to Mt. St. Helens several times and on the Thursday before the eruption, he knocked on my office door asking if I'd like to accompany him on a field trip to the mountain. I'd just given final exams for both of the courses that I'd taught that semester; grades were due to administration by 5 PM on the following Monday. Jim was hoping to get a good view and photograph any new eruptions and knew which back roads to take to get close to Mt. St. Helens. I apologized to him indicating that I had to complete grading exams and compile final grades for about 50 students by the following Monday. The process would take the remainder of the week and most of the week end. Jim left and I didn't think any more about his invitation and field trip until that fateful Sunday. At about 3 PM the sky had completely blackened and ash began falling with a distinctive sulfur dioxide (SO_2) odor: Mt. St. Helens had erupted at 8:32 AM PDT and it took until the early afternoon for the ash cloud to pass over the U of I. We didn't realize the magnitude or impact of the eruption for several days. Several centimeters of volcanic ash subsequently settled over the area because Moscow had been in the plume's direct downwind path. Nothing moved in the town for three days for fear of breathing in and clogging vehicle engines with the fine volcanic dust. Finally, impatience overtook the populace and the town and people began washing the volcanic ash from the streets.

On the third day, the skies cleared enough so that TV station helicopters began surveying the devastation. One close-up view, seven ridges away from the mountain, showed a purple Datsun hatch back with the back opened; it contained a body. This was Jim's vehicle. After recovering his body, an autopsy revealed that he had been without oxygen for ~15 to 20 minutes because the spent pyroclastic flow gases contained mostly carbon dioxide (CO_2) and SO_2. Several friends and colleagues hired a helicopter subsequently retrieving his dissertation maps; these were published and at the following year's graduation, his mother received his posthumous doctorate.

Further studies showed that the May 18th eruption was the largest known debris avalanche in recorded history.

When exposed, Mt. St. Helens' magma was released as a large-scale horizontal pyroclastic flow flattening



vegetation and buildings over 600 km^2 and emitting more that 1.5 million metric tons of SO_2. On the Volcanic Explosivity Index (VEI) scale, the eruption rated a 5.0 – a Plinian-type eruption [named for Pliny the Younger, a Roman scholar who described Mt. Vesuvius' eruption (see below)]. For comparison, Hawaiian volcanoes, e.g., Kilauea with its continuous rather nonexplosive lava flows, has a VEI = 0. The volcano Toba, which erupted 74,000 years ago with a volume of 1,000 km^3 and a vertical plume >25 km, has been given a VEI = 8 and is designated as Ultra Plinian.

Mt. St. Helen's northern flank's collapse resulted in volcanic ash and rock mixing with glacial ice, snow, and water creating volcanic mudflows (lahars) that ultimately flowed down the Toutle and Cowlitz River valleys, destroying roads, bridges, homes, and lumber camps. Mudflows transported about 3.0 million m^3 of material 27 km south to the Columbia River. The ash plume continued rising for nine hours, reaching an altitude of 20 to 27 km above sea level, then moving eastward at ~100 km/h with ash falling in Idaho by noon and reaching as far north as Edmonton, Canada. The eruption released 24 megatons of thermal energy (equivalent to TNT), ejecting more than 2.79 km^3 of material, reducing the volcano's height by ~400 m, and leaving a 1.6 to 3.2 km wide and 800 m deep crater. It killed 57 people, ~7,000 deer, elk, and bear, and ~12 million fish from a hatchery. It destroyed or damaged >200 homes, 298 km of roads and highways, and 24 km of railways.

The most famous of Plinian eruptions occurred in late August 79 CE at Mt. Vesuvius in Italy which suddenly erupted with a vertical ash column at the rate of 1.5 million tons per second. The ash cloud reached 15 to 30 km, ultimately releasing an estimated 16,000 megatons of thermal energy. Subsequent eruptive clouds (over 2-3 days) collapsed as gases (largely CO_2 and SO_2) expanded, losing the capability of supporting ash (tephra) fragments. The resulting pyroclastic surges reached the towns of Herculaneum and eventually Pompeii, burying them under several meters of tephra. These pyroclastic flows had internal temperatures reaching 500 ^oC. Magnetic studies of excavated roof tiles and plaster fragments collected around Pompeii suggest that on the first day's eruption, white pumice containing ~3.0 cm diameter clastic fragments fell for several hours heating tiles to ~140 °C. On the second day, pyroclastic surges resulted in depositional temperatures ranging to 300 °C. Any remaining persons in buildings could not have escaped because the city was enveloped by gases at incinerating temperatures. The lowest temperatures occurred in rooms under collapsed roofs of ~100 °C. About 16,000 people perished in these eruptions.

These historical volcanic eruptions are rather "tame" considering what's contained in the geological record. Scientists are just now beginning to understand in more detail how present and past eruptions have affected the Earth and I'll discuss these new findings in future articles.

Finally, Jim and I had a friendly wager on who would complete their graduate degrees first. The payment was a case of beer, winner's choice. He won and each May 18th I recall his devotion to science and geology; however, somehow I still need to pay off the debt.

Mt. St Helens memorial plaque at the visitor's center, Mt. St. Helens National Volcanic Monument,

Washington State. Jim Fitzgerald's name is in the left column, second from the top.

INHIGEO AT ASILOMAR July 2014

39th Symposium of the **International Commission on the History of Geological Sciences**, co-sponsored by the Geological Society of America. Asilomar Conference Grounds, Pacific Grove, California. Sunday 6 July (p.m.) through Thursday 10 July, 2014.

Everyone interested in the history of the geosciences is invited to this meeting, *the first INHIGEO symposium held in the U.S. since 1989*.

Dual conference themes:

(1) *Doing the History of the Earth Sciences: What, Why, and How?*

Keynote speakers: **Claudine Cohen** (École des Hautes Études en Sciences Sociales, Paris) & **Ernst Hamm** (York University, Toronto).

(2) *California's Place in the History of the Earth Sciences*

Keynote speakers: **Eldridge Moores** (University of California– Davis) & **William R. Dickinson** (University of Arizona).

For full details, visit the GSA Meetings webpage: http://community.geosociety.org/INHIGEO2014/Home/

Impact glass from asteroids and comets stores biodata for millions of years

The scorching heat produced by asteroid or comet impacts can melt tons of soil and rock, some of which forms glass as it cools. Some of that glass preserves bits of ancient plant material. Credit: A snapshot of ancient environmental conditions.

Bits of plant life encapsulated in molten glass by asteroid and comet impacts millions of years ago give geologists information about climate and life forms on the ancient Earth. Scientists exploring large fields of impact glass in Argentina suggest that what happened on Earth might well have happened on Mars millions of years ago. Martian impact glass could hold traces of organic compounds.

Asteroid and comet impacts can cause widespread ecological havoc, killing off plants and animals on regional or even global scales. But new research from Brown University shows that impacts can also preserve the signatures of ancient life at the time of an impact.

A research team led by Brown geologist Pete Schultz has found fragments of leaves and preserved organic compounds lodged inside glass created by a several ancient impacts in Argentina. The material could provide a snapshot of environmental conditions at the time of those impacts. The find also suggests that impact glasses could be a good place to look for signs of ancient life on Mars.

The work is published in the latest issue of *Geology Magazine*.

The scorching heat produced by asteroid or comet impacts can melt tons of soil and rock, some of which forms glass as it cools. The soil of eastern Argentina, south of Buenos Aires, is rife with impact glass created by at least seven different impacts that occurred between 6,000 and 9 million years ago, according to Schultz. One

of those impacts, dated to around 3 million years ago, coincides with the disappearance of 35 animal genera, as reported in the journal *Science* a few years back.

"We know these were major impacts because of how far the glass is distributed and how big the chunks are," Schultz said. "These glasses are present in different layers of sediment throughout an area about the size of Texas."

Within glass associated with two of those impacts -- one from 3 million years ago and one from 9 million years ago -- Schultz and his colleagues found exquisitely preserved plant matter. "These glasses preserve plant morphology from macro features all the way down to the micron scale," Schultz said. "It's really remarkable."

The glass samples contain centimeter-size leaf fragments, including intact structures like papillae, tiny bumps that line leaf surfaces. Bundles of vein-like structures found in several samples are very similar to modern pampas grass, a species common to that region of Argentina.

Chemical analysis of the samples also revealed the presence of organic hydrocarbons, the chemical signatures of living matter.

To understand how these structures and compounds could have been preserved, Schultz and his colleagues tried to replicate that preservation in the lab. They mixed pulverized impact glass with fragments of pampas grass leaves and heated the mixture at various temperatures for various amounts of time. The experiments showed that plant material was preserved when the samples were quickly heated to above 1,500 degrees Celsius.

It appears, Schultz says, that water in the exterior layers of the leaves insulates the inside layers, allowing them to stay intact. "The outside of the leaves takes it for the interior," he said. "It's a little like deep frying. The outside fries up quickly but the inside takes much longer to cook."

Implications for Mars

If impact glass can preserve the signatures of life on Earth, it stands to reason that it could do the same on Mars, Schultz says. And the soil conditions in Argentina that contributed to the preservation of samples in this study are not unlike soils found on Mars.

The Pampas region of Argentina is covered with thick layers of windblown sediment called loess. Schultz believes that when an object impacts this sediment, globs of melted material roll out from the edge of the impact area like molten snowballs. As they roll, they collect material from the ground and cool quickly -- the dynamics that the lab experiments showed were important for preservation. After the impact, those glasses are slowly covered over as dust continues to accumulate. That helps to preserve both the glasses and the stowaways within them for long periods -- in the Argentine case, for millions of years.

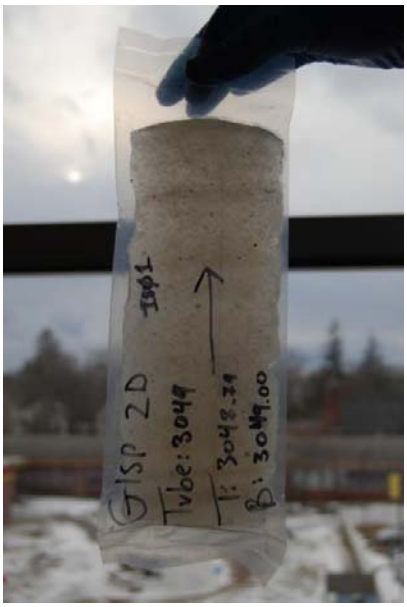
Much of the surface of Mars is covered in a loess-like dust, and the same mechanism that preserved the Argentine samples could also work on Mars.

"Impact glass may be where the 4 billion-year-old signs of life are hiding," Schultz said. "On Mars they're probably not going to come out screaming in the form of a plant, but we may find traces of organic compounds, which would be really exciting."

Story Source: The above story is based on materials provided by Brown University and ScienceDaily, April 18, 2014

Journal Reference: P. H. Schultz, R. S. Harris, S. J. Clemett, K. L. Thomas-Keprta, M. Zarate. **Preserved flora and organics in impact melt breccias**. *Geology*, 2014; DOI: 10.1130/G35343.1

There's something ancient in the icebox: Three-million-year-old landscape beneath



This is a piece of the GISP2 ice core showing silt and sand embedded in ice. Soon after this picture was taken, the ice was crushed in the University of Vermont clean lab and the sediment was isolated for analysis. Credit: Paul Bierman, University of Vermont

Glaciers are commonly thought to work like a belt sander. As they move over the land they scrape off everything -- vegetation, soil, and even the top layer of bedrock. So scientists were greatly surprised to discover an ancient tundra landscape preserved under the Greenland Ice Sheet, below two miles of ice.

"We found organic soil that has been frozen to the bottom of the ice sheet for 2.7 million years," said University of Vermont geologist Paul Bierman -- providing strong evidence that the Greenland Ice Sheet

has persisted much longer than previously known, enduring through many past periods of global warming.

He led an international team of scientists that reported their discovery on April 17 in the journal *Science.*

Antique landscapes

Greenland is a place of great interest to scientists and policymakers since the future stability of its huge ice sheet -- the size of Alaska, and second only to Antarctica -- will have a fundamental influence on how fast and high global sea levels rise from human-caused climate change.

"The ancient soil under the Greenland ice sheet helps to unravel an important mystery surrounding climate change," said Dylan Rood a co-author on the new study from the Scottish Universities Environmental Research Centre and the University of California, Santa Barbara, "how did big ice sheets melt and grow in response to changes in temperature?"

The new discovery indicates that even during the warmest periods since the ice sheet formed, the center of Greenland remained stable; "it's likely that it did not fully melt at any time," Vermont's Bierman said. This allowed a tundra landscape to be locked away, unmodified, under ice through millions of years of global warming and cooling.

"The traditional knowledge about glaciers is that they are very powerful agents of erosion and can effectively strip a landscape clean," said study co-author Lee Corbett, a UVM graduate student who prepared the silty ice samples for analysis. Instead, "we demonstrate that the Greenland Ice Sheet is not acting as an agent of erosion; in fact, at it's center, it has performed incredibly little erosion since its inception almost three million years ago."

Rather than scraping and sculpting the landscape, the ice sheet has been frozen to the ground, "a refrigerator that's preserved this antique landscape," Bierman said.

Cosmic signal

The scientists tested seventeen "dirty ice" samples from the bottommost forty feet of the 10,019-foot GISP2 ice core extracted from Summit, Greenland, in 1993. "Over twenty years, only a few people had looked hard at the sediments from the bottom of the core," Bierman said. From this sediment, he and a team at the University of Vermont's Cosmogenic Nuclide Laboratory extracted a rare form of the element beryllium, an isotope called beryllium-10. Formed by cosmic rays, it falls from the sky and sticks to rock and soil. The longer soil is exposed at Earth's surface, the more beryllium-10 it accumulates. Measuring how much is in soil or a rock gives geologists a kind of exposure clock.

The researchers expected to only find soil eroded from glacier-scoured bedrock in the sediment at the bottom of the ice core. "So we thought we were going looking for a needle in haystack," Bierman said. They planned to work diligently to find vanishingly small amounts of the beryllium -- since the landscape under the ice sheet would have not been exposed to the sky. "It turned out that we found an elephant in a haystack," he said; the silt had very high concentrations of the isotope when the team measured it on a particle accelerator at Lawrence Livermore National Laboratory.

"On a global basis, we only find these sorts of beryllium concentrations in soils that have developed over hundreds of thousands to millions of years," said Joseph Graly, who analyzed the beryllium data while at the University of Vermont.

The new research, supported by funding from the National Science Foundation, shows that "the soil had been stable and exposed at the surface for somewhere between 200,000 and one million years before being covered by ice," notes Ben Crosby, a member of the research team from Idaho State University.

To help interpret these unexpected findings, the team also measured nitrogen and carbon that could have been left by plant material in the core sample. "The fact that measurable amounts of organic material were found in the silty ice indicates that soil must have been present under the ice," said co-author Andrea Lini at the University of Vermont -- and its composition suggests that the pre-glacial landscape may have been a partially forested tundra.

"Greenland really was green! However, it was millions of years ago," said Rood, "Greenland looked like the green Alaskan tundra, before it was covered by the second largest body of ice on Earth." To confirm their findings about this ancient landscape, the researchers also measured beryllium levels in a modern permafrost tundra soil on the North Slope of Alaska. "The values were very similar," said Bierman, "which made us more confident that what we found under Greenland was tundra soil."

Future tense

Many geologists are seeking a long-term view of the history of the Greenland Ice Sheet, including how it moves and has shaped the landscape beneath it -- with an eye toward better understanding its future behavior. It's 656,000 square miles of ice, containing enough water, if fully melted, to raise global sea levels twenty-three feet -- "yet we have very little information about what is happening at the bed with regards to erosion and landscape formation," said Corbett.

What is clear, however, from an abundance of worldwide indicators, is that global temperatures are on a path to be "far warmer than the warmest interglacials in millions of years," said Bierman. "There is a 2.7-million-year-old soil sitting under Greenland. The ice sheet on top of it has not disappeared in the time in which humans became a species. But if we keep on our

current trajectory, the ice sheet will not survive. And once you clear it off, it's really hard to put it back on."

Story Source: The above story is based on materials provided by University of Vermont. The original article was written by Joshua E. Brown and ScienceDaily April 17, 2014

Journal Reference: Paul R. Bierman, Lee B. Corbett, Joseph A. Graly, Thomas A. Neumann, Andrea Lini, Benjamin T. Crosby, Dylan H. Rood. **Preservation of a Preglacial Landscape Under the Center of the Greenland Ice Sheet**. *Science*, 2014 DOI: 10.1126/science.1249047

Tiny mountainous region in Siberia may have been genetic source of earliest Native Americans

Matthew Dulik and Theodore Schurr; *Credit: Image courtesy of University of Pennsylvania*

A tiny mountainous region in southern Siberia may have been the genetic source of the earliest Native Americans, according to new research by a University of Pennsylvania-led team of anthropologists.

Lying at the intersection of what is today Russia, Mongolia, China and Kazakhstan, the region known as the Altai "is a key area because it's a place that people have been coming and going for thousands and thousands of years," said Theodore Schurr, an associate professor in Penn's Department of Anthropology. Schurr, together with doctoral student Matthew Dulik and a team of graduate students and postdoctoral researchers, collaborated on the work with Ludmila Osipova of the Institute of Cytology and Genetics in Novosibirsk, Russia.

Among the people who may have emerged from the Altai region are the predecessors of the first Native Americans. Roughly 20-25,000 years ago, these prehistoric humans carried their Asian genetic lineages up into the far reaches of Siberia and eventually across the then-exposed Bering land mass into the Americas.

"Our goal in working in this area was to better define what those founding lineages or sister lineages are to Native American populations," Schurr said.

The team's study, published in the American Journal of Human Genetics, analyzed the genetics of individuals living in Russia's Altai Republic to identify markers that might link them to Native Americans. Prior ethnographic studies had found distinctions between tribes in the northern and southern Altai, with the northern tribes apparently linked linguistically and culturally to ethnic groups farther to the north, such as the Uralic or Samoyedic populations, and the southern groups showing a stronger connection to Mongols, Uighurs and Buryats.

Schurr and colleagues assessed the Altai samples for markers in mitochondrial DNA, which is maternally inherited, and in Y chromosome DNA, which is passed from fathers to sons. They also compared the samples to ones previously collected from individuals in southern Siberia, Central Asia, Mongolia, East Asia and a variety of American indigenous groups. Because of the large number of gene markers examined, the findings have a high degree of precision.

"At this level of resolution we can see the connections more clearly," Schurr said.

Looking at the Y chromosome DNA, the researchers found a unique mutation shared by Native Americans and southern Altaians in the lineage known as Q.

"This is also true from the mitochondrial side," Schurr said. "We find forms of haplogroups C and D in southern Altaians and D in northern Altaians that look like some of the founder types that arose in North America, although the northern Altaians appeared more distantly related to Native Americans."

Calculating how long the mutations they noted took to arise, Schurr's team estimated that the southern Altaian lineage diverged genetically from the Native American lineage 13,000 to 14,000 years ago, a timing scenario that aligns with the idea of people moving into the Americas from Siberia between 15,000 and 20,000 years ago.

Though it's possible, even likely, that more than one wave of people crossed the land bridge, Schurr said that other researchers have not yet been able to identify a similar geographic focal point from which Native Americans can trace their heritage.

"It may change with more data from other groups, but, so far, even with intensive work in Mongolia, they're not seeing the same things that we are," he said.

In addition to elucidating the Asia-America connection, the study confirms that the modern cultural divide between southern and northern Altaians has ancient genetic roots. Southern Altaians appeared to have had greater genetic contact with Mongolians than they did

with northern Altaians, who were more genetically similar to groups farther to the north.

However, when looking at the Altaians' mitochondrial DNA in isolation, the researchers did observe greater connections between northern and southern Altaians, suggesting that perhaps females were more likely to bridge the genetic divide between the two populations.

"Subtle differences here both reflect the Altaians themselves -- the differentiation among those groups -- and allow us to try to point to an area where some of these precursors of American Indian lineages may have arisen," Schurr said.

Moving forward, Schurr and his team hope to continue to use molecular genetic techniques to trace the movement of peoples within Asia and into and through the Americas. They may also attempt to identify links between genetic variations and adaptive physiological responses, links that could inform biomedical research.

For example, Schurr noted that both Siberians and Native American populations "seem to be susceptible to Westernization of diet and moving away from traditional diets, but their responses in terms of blood pressure and fat metabolism and so forth actually differ."

Using genomic approaches along with traditional physical anthropology may lend insight into the factors that govern these differences.

In addition to Schurr and Dulik, the research was conducted by Sergey Zhadanov, Ayken Askapuli, Lydia Gau, Omer Gokcumen and Samara Rubinstein of Penn's Department of Anthropology.

The study was supported by the University of Pennsylvania, the National Science Foundation, the Social Sciences and Humanities Research Council of Canada and the Russian Basic Fund for Research. The National Geographic Society also provided infrastructural support to the Schurr lab.

Story Source: The above story is based on materials provided by University of Pennsylvania and ScienceDaily, January 26, 2012.

Journal Reference: Askapuli, Lydia Gau, Omer Gokcumen, Samara Rubinstein, Theodore G. Schurr. **Mitochondrial DNA and Y Chromosome Variation Provides Evidence for a Recent Common Ancestry between Native Americans and Indigenous Altaians**. *The American Journal of Human Genetics*, 2012; DOI: 10.1016/j.ajhg.2011.12.014

Inbreeding in woolly mammoths: Neck rib provide clues about decline and eventual extinction

Researchers recently noticed that the remains of woolly mammoths from the North Sea often possess a 'cervical' (neck) rib -- in fact, 10 times more frequently than in modern elephants (33.3% versus 3.3%). In modern animals, these cervical ribs are often associated with inbreeding and adverse environmental conditions during pregnancy. If the same factors were behind the anomalies in mammoths, this reproductive stress could have further pushed declining mammoth populations towards ultimate extinction.

Mammals, even the long-necked giraffes and the short-necked dolphins, almost always have seven neck vertebrae (exceptions being sloths, manatees and dugongs), and these vertebrae do not normally possess a rib. Therefore, the presence of a 'cervical rib' (a rib attached to a cervical vertebra) is an unusual event, and is cause for further investigation. A cervical rib itself is relatively harmless, but its development often follows genetic or environmental disturbances during early embryonic development. As a result, cervical ribs in most mammals are strongly associated with stillbirths and multiple congenital abnormalities that negatively impact the lifespan of an individual.

The arrow indicates a large articulation facet of a cervical rib on a fossil cervical vertebra of a woolly mammoth of the Natural History Museum Rotterdam. Credit: Joris van Alphen

Researchers from the Rotterdam Museum of Natural History and the Naturalis Biodiversity Center in Leiden examined mammoth and modern elephant neck vertebrae from several European museum collections. "It had aroused our curiosity to find two cervical vertebrae, with large articulation facets for ribs, in the mammoth samples recently dredged from the North Sea. We knew these were just about the last mammoths living there, so we suspected something was happening. Our work now shows that there was indeed a problem in this population," said Jelle Reumer, one of the authors on the study published today in the open access journal *PeerJ*.

The incidence of abnormal cervical vertebrae in mammoths is much higher than in the modern sample, strongly suggesting a vulnerable condition in the species.

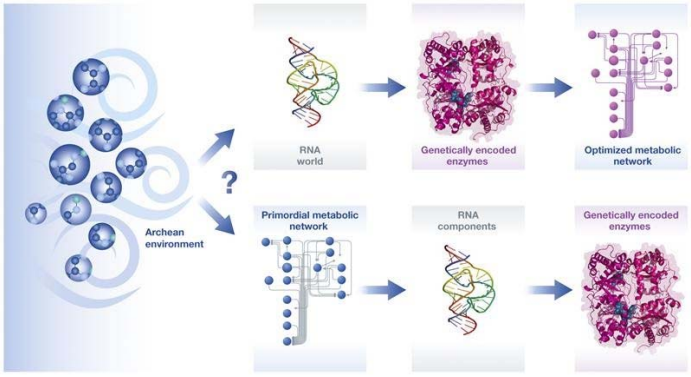
Potential factors could include inbreeding (in what is assumed to have been an already small population) as well as harsh conditions such as disease, famine, or cold, all of which can lead to disturbances of embryonic and fetal development. Given the considerable birth defects that are associated with this condition, it is very possible that developmental abnormalities contributed towards the eventual extinction of these late Pleistocene mammoths.

The peer-reviewed study, entitled "Extraordinary incidence of cervical ribs indicates vulnerable condition in Late Pleistocene mammoths" was authored by Jelle Reumer of the Rotterdam Museum of Natural History and Clara ten Broek and Frietson Galis of Naturalis Biodiversity Center (Leiden).

Story Source: The above story is based on materials provided by PeerJ and ScienceDaily March 25, 2014.

Journal Reference: Jelle W.F. Reumer, Clara M.A. ten Broek, Frietson Galis. **Extraordinary incidence of cervical ribs indicates vulnerable condition in Late Pleistocene mammoths**. *PeerJ*, 2014; 2: e318 DOI: 10.7717/peerj.318

Reconstructed Ancient Ocean Reveals Secrets



A reconstruction of Earth's earliest ocean in the laboratory revealed the spontaneous occurrence of the chemical reactions used by modern cells to synthesize many of the crucial organic molecules of metabolism (bottom pathway). Whether and how the first enzymes adopted the metal-catalyzed reactions described by the scientists remain to be established. Credit: Molecular Systems Biology / Creative Commons Attribution Non Commercial License (CC BY-NC 3.0)

Researchers from the University of Cambridge have published details about how the first organisms on Earth could have become metabolically active. The results, which are reported in the journal *Molecular Systems Biology*, permit scientists to speculate how primitive cells learned to synthesize their organic components -- the molecules that form RNA, lipids and amino acids. The findings also suggest an order for the sequence of events that led to the origin of life.

A reconstruction of Earth's earliest ocean in the laboratory revealed the spontaneous occurrence of the chemical reactions used by modern cells to synthesize many of the crucial organic molecules of metabolism. Previously, it was assumed that these reactions were carried out in modern cells by metabolic enzymes, highly complex molecular machines that came into existence during the evolution of modern organisms.

Almost 4 billion years ago life on Earth began in iron-rich oceans that dominated the surface of the planet. An open question for scientists is when and how cellular metabolism, the network of chemical reactions necessary to produce nucleic acids, amino acids and lipids, the building blocks of life, appeared on the scene.

The observed chemical reactions occurred in the absence of enzymes but were made possible by the chemical molecules found in the Archean sea. Finding a series of reactions that resembles the "core of cellular metabolism" suggests that metabolism predates the origin of life. This implies that, at least initially, metabolism may not have been shaped by evolution but by molecules like RNA formed through the chemical conditions that prevailed in the earliest oceans.

"Our results demonstrate that the conditions and molecules found in the Earth's ancient oceans assisted and accelerated the interconversion of metabolites that in modern organisms make up glycolysis and the pentose-phosphate pathways, two of the essential and most centrally placed reaction cascades of metabolism," says Dr. Markus Ralser, Group Leader at the Department of Biochemistry at the University of Cambridge and the National Institute for Medical Research. "In our reconstructed version of the ancient Archean ocean, these metabolic reactions were particularly sensitive to the presence of ferrous iron that helped catalyze many of the chemical reactions that we observed." From the analysis of early oceanic sediments, geoscientists such as Alexandra V. Turchyn from the Department of Earth Sciences at the University of Cambridge, one of the co-authors of the study, concluded that soluble forms of iron were one of the most frequently found molecules in the prebiotic oceans.

The scientists reconstructed the conditions of this prebiotic sea based on the composition of various early sediments described in the scientific literature. The different metabolites were incubated at high temperatures (50-90oC) similar to what might be expected close to a hydrothermal vent of an oceanic volcano, a temperature that would not support the activity of conventional protein enzymes. The chemical products were separated and analyzed by liquid chromatography tandem mass spectrometry.

Some of the observed reactions could also take place in water but were accelerated by the presence of metals that served as catalysts. "In the presence of iron and other compounds found in the oceanic sediments, 29 metabolic-like chemical reactions were observed, including those that produce some of the essential chemicals of metabolism, for example precursors of the building blocks of proteins or RNA," says Ralser. "These results indicate that the basic

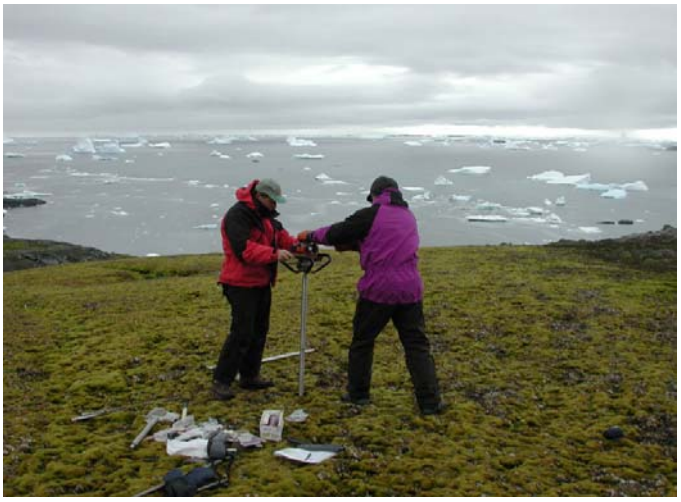
architecture of the modern metabolic network could have originated from the chemical and physical constraints that existed on the prebiotic Earth."

The detection of one of the metabolites, ribose 5-phosphate, in the reaction mixtures is particularly noteworthy. Its availability means that RNA precursors could in theory give rise to RNA molecules that encode information, catalyze chemical reactions and replicate. Whether and how the first enzymes adopted the metal-catalyzed reactions described by the scientists remain to be established.

Story Source: The above story is based on materials provided by European Molecular Biology Organization and ScienceDaily, April 25, 2014.

Journal Reference: Markus A Keller, Alexandra V Turchyn Markus Ralser. Non-enzymatic glycolysis and pentose phosphate pathway-like reactions in a plausible Archean ocean, Molecular Systems Biology, 2014; DOI: 10.1002/msb.20145228

Back to life after 1,500 years: Moss brought back to life after 1,500 years frozen in ice



This image shows drilling in the moss banks of Signy during the coring project in which the paper's core was obtained. Credit: P. Boelen

Researchers from the British Antarctic Survey and Reading University have demonstrated that, after over 1,500 years frozen in Antarctic ice, moss can come back to life and continue to grow. For the first time, this vital part of the ecosystem in both polar regions has been shown to have the ability to survive century to millennial scale ice ages. This provides exciting new insight into the survival of life on Earth.

The team, reporting in *Current Biology* this week, observed moss regeneration after at least 1,530 years frozen in permafrost. This is the first study to show such long-term survival in any plant; similar timescales have only been seen before in bacteria. Mosses are known to survive environmental extremes in the short-term with previous evidence confirming up to a 20 year timescale for survival. Their potential to survive much longer timescales had not previously been examined.

Mosses are an important part of the biology of both polar regions. They are the dominant plants over large areas and are a major storer of fixed carbon, especially in the north.

Co-author Professor Peter Convey from the British Antarctic Survey explains: "What mosses do in the ecosystem is far more important than we would generally realize when we look at a moss on a wall here for instance. Understanding what controls their growth and distribution, particularly in a fast-changing part of the world such as the Antarctic Peninsula region, is therefore of much wider significance."

The team took cores of moss from deep in a frozen moss bank in the Antarctic. This moss would already have been at least decades old when it was first frozen. They sliced the frozen moss cores very carefully, keeping them free from contamination, and placed them in an incubator at a normal growth temperature and light level. After only a few weeks, the moss began to grow. Using carbon dating, the team identified the moss to be at least 1,530 years of age, and possibly even older, at the depth where the new growth was seen.

According to Professor Convey: "This experiment shows that multi-cellular organisms, plants in this case, can survive over far longer timescales than previously thought. These mosses, a key part of the ecosystem, could survive century to millennial periods of ice advance, such as the Little Ice Age in Europe.

"If they can survive in this way, then recolonisation following an ice age, once the ice retreats, would be a lot easier than migrating trans-oceanic distances from warmer regions. It also maintains diversity in an area that would otherwise be wiped clean of life by the ice advance.

"Although it would be a big jump from the current finding, this does raise the possibility of complex life forms surviving even longer periods once encased in permafrost or ice."

Story Source: The above story is based on materials provided by British Antarctic Survey and ScienceDaily, March 17, 2014.

Journal Reference: Esme Roads, Royce E. Longton, Peter Convey. **Millennial timescale regeneration in a moss from Antarctica,** *Current Biology*, Volume 24, Issue 6, 17 March 2014, Pages R222-R223 DOI: 10.1016/j.cub.2014.01.053

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NCGS DINNER MEETING Wednesday May 28, 2014

6:00 PM at Orinda Masonic Center

"WHY DON'T VERTIBRATES CARE ABOUT MASS EXTINCTIONS?"

Speaker: Dr. Kevin Padian, Professor and Curator, Department of Integrative Biology and Museum of Paleontology, University of California, Berkeley

(Reservations are required by May 23, 2013, Limit 100 persons)
We are sorry but we will not be able to accommodate "walk-ins"

This is NCGS 's 70th anniversary. Stepping out of our normal routine, the **Northern California Geological Society** is pleased to announce this *special dinner and evening* with **Dr. Kevin Padian**. 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 note that a vegetarian option is available if notified ahead (please see the registration form below).

Abstract:

We know that there have been five major mass extinctions in the history of life. The problem is, no one told the vertebrates. We don't have any serious evidence that terrestrial vertebrates have experienced heightened extinction rates during episodes when marine invertebrates have dropped in diversity. There is absolutely no convincing evidence for synchronicity between marine and terrestrial realms in these troubled times. But wait, it gets worse: we have no standard definition of mass extinction. So how do we know when a mass extinction has occurred? Worse than that, we don't differentiate between increases in extinction rate and drops in origination rates when it comes to changes in net diversity. So it's like not making a difference in going broke between losing your job and spending all your wages at the track. Is it any wonder we're so confused?

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

Meeting Details: Social Hour: 6:00 – 7:00 pm; Dinner: 7:00 – 8:00 pm **Presentation**: 8:00 – open
Time: May 28, 2014, 6:00 pm, Orinda Masonic Center 9 Altarinda Road, Orinda, CA. **Cost**: **$25/person**

**********REGISTRATION FORM (Dr. Kevin Padiane's Dinner) **********

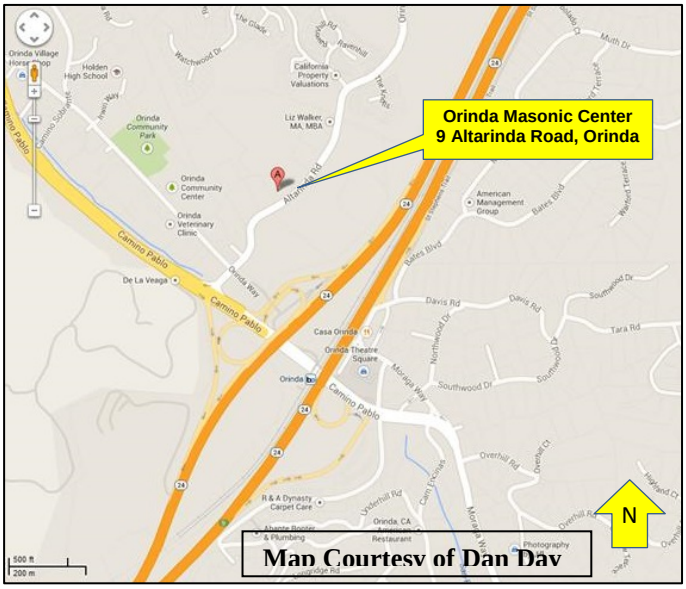
Name:_____ E-mail:_____

Phone (day):_____ Phone (cell) _____

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

Please mail a check made out to **NCGS** to: **Tridib Guha**
5016 Gloucester Lane
Martinez, CA 94553

Questions: e-mail: tridibguha@yahoo.com Phone: (925) 451-1999



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

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