NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

MEETING ANNOUNCEMENT

DATE: **April 30, 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: **Stephen D. Reynolds**
California Geological Survey

Reclamation of the abandoned Spenceville Copper Mine

Unfortunately we do not have an abstract for this month's talk; however, based on the available information and Stephen's extensive experience in this area of interest, it should be interesting.

Biography: **Stephen Reynolds** is a Senior Engineering Geologist with the California Geological Survey's (CGS) Forest and Watershed Geology Group. He is a Professional Geologist (PG), Certified Engineering Geologist (CEG), and a Certified Hydrogeologist (CHG) in the state of California. He has 35 years experience focusing on environmental geology. He has previously been employed at the California Department of Water Resources (DWR), California Department of Toxic Substances Control (DTSC), Corps of Engineers, and the State Abandoned Mine Land Program.

NCGS 2012 – 2013 Calendar

May 28, 2014 DINNER MEETING 6:00 P.M. Start
Dr. Kevin Padian, Professor and Curator, Department of Integrative Biology and Museum of Paleontology, University of California, Berkeley
Why don't vertebrates care about mass extinctions?

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/.

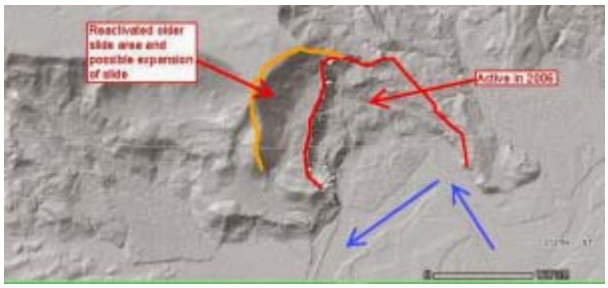
NCGS Board Meeting Announcement

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.

Stillaguamish Landslide- Geologic Perspectives

Posted on March 24, 2014 by magmatist
Submitted by John Christian



Interpretation of landslide scarp on LiDAR image, by Dan McShane. ***Click image to enlarge****.*

Dan McShane has written some geologic perspectives about Saturday's landslide into the Stillaguamish River. Dan is a consulting geologist based in Bellingham and author of 'Washington Landscapes' blog, and has some great insights into the geology and history of the slide area. Rather than trying to rewrite his excellent reports, I'll just provide the links. It is not the first landslide in this location. In my view, it is a tragedy that people are permitted to live in this location.

Dan's Initial report:

http://washingtonlandscape.blogspot.com/2014/03/arm-waving-notes-on-stilliguamish.html

Geologic background:

http://washingtonlandscape.blogspot.com/2014/03/geology-of-silliguamish-blocking-slide.html

LiDAR images and slide history.

http://washingtonlandscape.blogspot.com/2014/03/aerial-history-and-lidar-of.html

How Rare is Rare? (Part 2)

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.

In Part 1 (March 2011 Vortex) I discussed why the Rare Earth Elements (REE) were really not so rare. In fact, their crustal abundances exceed that of gold, silver, copper, and lead. While not common, the latter metals are more easily accessible; gold generally occurs as a native metal, and silver, copper, and lead, generally occur as sulfides, which are easily extracted from their respective minerals and ores. However, the REE occur in

more complex minerals contained in rather rare rock types. Another method for determining the rarity or abundance of a mineral commodity is to examine its clarke number or value. Frank Wigglesworth Clarke (1847 to 1931), American scientist, educator, and geologist, was sometimes known as the "Father of Geochemistry." and is also credited with the first elemental determination of Earth's crustal composition. A "clarke" is equal to the average abundance of an element in the Earth's crust and the "clarke of concentration" would equal the concentration of an element in a mineral or rock when compared with its average crustal concentration. For example, the clarke of copper is about 55 mg/kg, or 0.006% (55/10,000). In the mineral chalcocite (Cu_2S), the copper concentration is 79.8%. Thus, the clarke of concentration within this mineral is 79.8/0.006, or 13,300. For Ce, the clarke is 70 mg/kg or 0.007% and in the mineral bastnäsite (see below) the Ce concentration is 63.94% and the clarke of concentration is 63.94/0.007 or 9,134. Therefore, based on the clarke, on a relative abundance scale, Ce's abundance is comparable to Cu.

Mineralogy: One of the primary REE-bearing minerals is bastnäsite (or bastnaesite), which actually occurs as a group or family of three carbonate-fluoride minerals. Bastnäsite is a lananthum-cerium fluoro carbonate [(Ce, La)CO_3F] with varying concentrations of Ce and La. Although most bastnäsite is Ce-bearing, Y types may also occur as (Y, Ce)CO_3F. Monazite, a REE-bearing phosphate, actually occurs as three distinctive minerals, all having different REE compositions and percentages: (1) cerium monazite [(Ce, La, Nd, Th, Y)PO4], (2) lanthanum monazite [(La, Ce, Nd)PO4], and (3) neodymium monazite [(Nd, La, Ce)PO4]. Bastnäsite and monazite are the two largest sources of Ce and other REE.

Petrology and Ore Deposits: The geologic setting of REE-bearing minerals in economic concentrations usually occurs within or a variety of rock types and mineralizing events. The most significant economic concentrations are hosted in, or associated with, alkaline and peralkaline igneous rocks and carbonatites. These rare rocks form from magmas derived by partial melting of rocks within the Earth's mantle. Based on bulk whole rock chemistry, such igneous rocks are generally classified as *peralkaline* (literally meaning "with excess alkalis") when $Na_2O+K_2O>Al_2O_3$ and *peraluminous* (meaning "excess alumina") when $Al_2O_3>Na_2O+K_2O$. Upon ascent into the Earth's crust, such magmas undergo significant changes in their chemical composition due to changes in pressure, temperature, composition of surrounding rocks, and finally hydrothermal alteration. This results in a diversity of rock types enriched in zirconium, niobium, strontium, barium, lithium, thorium, uranium, and the REE. Associated mineral deposits therefore are quite diverse and difficult to classify, because the distinctive features of these deposits and their rarity generally result in classifications that have only one or at most, a few known examples.

Carbonatites are very rare and unique intrusive igneous rock bodies, commonly found as stocks (intrusions less than 100 km^2) but they may also occur as dikes and veins composed of more than 50% carbonate minerals, predominantly calcite ($CaCO_3$) and dolomite [$CaMg(CO_3)_2$]. One of the most famous carbonatite deposits is at Mountain Pass, in California's upper Mojave Desert (west of Las Vegas and just north of Interstate 5). Discovered in 1949, by 1966, it had become a world-class deposit owned and operated by Molycorp, Inc. and it became the major source of light REE (LREE), particularly Eu used in color television sets. The orebody consists of carbonatite dikes composed of 40% calcite, 25% barite ($BaSO_4$), 11% bastnaesite, 10% strontianite ($SrCO_3$) and 8% quartz (SiO_2). The average ore grade is 9.3% LREE with estimated reserves in 2008 exceeding 20 Mt rare earth oxides (REO) with a 5% cutoff grade. Mountain Pass ceased active mining in 2002 because of environmental restrictions and lower REE prices but continued processing previously mined ore. In December 2010, Molycorp obtained the required environmental and construction permits for a new mine ore processing plant; construction began in January 2011 with completion scheduled by the end of 2012.

Other deposits: Within hydrothermal systems, REE minerals can also occur in quartz (SiO_2) veins, fluorite-bearing ($CaPO_4$) veins and associated breccias (broken rock) fillings. REE minerals also form in skarn deposits (those formed along contacts of igneous intrusions and surrounding country rocks), and in pegmatites (very coarse grained igneous rocks with the mineral composition of granite). They may also occur as secondary deposits when REE-bearing minerals become concentrated in placer and lateritic clays. REE are also extracted as by-products from uranium and niobium milling process.

Outside of the U.S., other important REE deposits include the Chinese Bayan Obo iron-niobium-REE deposit of Inner Mongolia, which has similarities to carbonatite REE deposits and to hydrothermal iron-oxide-copper-gold-REE deposits, such as Olympic Dam REE deposit of Australia and the Kiruna deposit in Sweden. The Bayan Obo ore grades range from 3 to 6% REO, with reserves of at least 40 Mt. The second major source of Chinese REE are the REE ion-adsorption oxide ore deposits occurring in lateritic weathering crusts and soils that form on granitic and syenitic rocks in southern China's tropics. These oxide ores have relatively high proportions of HREE that can be easily mined and extracted.

In Part 3, I'll discuss some of the uses of REE, their current prices, environmental problems associated with extraction and processing, and forensic geochemistry.

Bering Land Bridge a long-term refuge for early Americans

A photo of Alaska's shrub tundra environment today showing birch shrubs in the foreground and spruce trees scattered around Eight Mile Lake, located in the foothills of the Alaska Range. Credit: Nancy Bigelow, University of Alaska Fairbanks

Genetic and environmental evidence indicates that after the ancestors of Native Americans left Asia, they spent 10,000 years in shrubby lowlands on a broad land bridge that once linked Siberia and Alaska. Archaeological evidence is lacking because it drowned beneath the Bering Sea when sea levels rose.

University of Utah anthropologist Dennis O'Rourke and two colleagues make that argument in the Friday, Feb. 28, issue of the journal *Science*. They seek to reconcile existing genetic and paleoenvironmental evidence for human habitation on the Bering land bridge -- also called Beringia -- with an absence of archaeological evidence.

O'Rourke says cumulative evidence indicates the ancestors of Native Americans lived on the Bering land bridge "in the neighborhood of 10,000 years," from roughly 25,000 years ago until they began moving into the Americas about 15,000 years ago once glacial ice sheets melted and opened migration routes.

O'Rourke co-authored the *Science* Perspective column -- titled "Out of Beringia?" -- with archaeologist John Hoffecker of the University of Colorado at Boulder, and Scott Elias, a paleoecologist at the University of London. Perspective columns in *Science* don't feature research by the authors, but instead are meant to highlight and provide context for exciting new research in a field or across fields.

"Nobody disputes that the ancestors of Native American peoples came from Asia over the coast and interior of the land bridge" during an ice age called the "last glacial maximum," which lasted from 28,000 to at least 18,000 years ago, O'Rourke says,

The ice sheets extended south into the Pacific Northwest, Wyoming, Wisconsin and Ohio. Large expanses of Siberia and Beringia were cold but lacked glaciers.

The absence of archaeological sites and the inhospitable nature of open, treeless landscape known as tundra steppe mean that "archaeologists have not given much credence to the idea there was a population that lived on the Bering land bridge for thousands of years," he adds.

O'Rourke and colleagues say that in recent years, paleoecologists -- scientists who study ancient environments -- drilled sediment cores from the Bering Sea and Alaskan bogs. Those sediments contain pollen, plant and insect fossils, suggesting the Bering land bridge wasn't just barren, grassy tundra steppe but was dotted by "refugia" or refuges where there were brushy shrubs and even trees such as spruce, birch, willow and alder.

"We're putting it together with the archaeology and genetics that speak to American origins and saying, look, there was an environment with trees and shrubs that was very different than the open, grassy steppe. It was an area where people could have had resources, lived and persisted through the last glacial maximum in Beringia," O'Rourke says. "That may have been critical for the people to subsist because they would have had wood for construction and for fires. Otherwise, they would have had to use bone, which is difficult to burn."

A Frozen, Isolated Dawn for the Earliest Americans

During the last glacial maximum, thick glacial ice sheets extended south into what now is the northern United States, sea levels dropped some 400 feet, O'Rourke says. As the glaciers melted, sea levels began to rise, reaching current levels 6,000 years ago.

During the long glacial period, Siberia and Alaska were linked by the Bering land bridge, which contrary to the name's implication, really was a huge swath of land north, between and south of Siberia and Alaska, at the present sites of the Chukchi Sea, the Bering Strait and the Bering Sea, respectively.

At its largest extent, Beringia measured as much as 1,000 miles from north to south and as much as 3,000 miles from Siberia's Verkoyansk Range east to the Mackenzie River in in Canada.

The theory that humans inhabited the Bering land bridge for some 10,000 years "helps explain how a Native American genome (genetic blueprint) became separate from its Asian ancestor," O'Rourke says.

"At some point, the genetic blueprint that defines Native American populations had to become distinct from that Asian ancestry," he explains. "The only way to do that was for the population to be isolated. Most of us don't believe that isolation took place in Siberia because we don't see a place where a population could be

sufficiently isolated. It would always have been in contact with other Asian groups on its periphery."

"But if there were these shrub-tundra refugia in central Beringia, that provided a place where isolation could occur" due to distance from Siberia, O'Rourke says.

Genetic and Paleoenvironmental Evidence

O'Rourke and colleagues point to a study of mitochondrial DNA -- genetic information passed by mothers -- sampled from Native Americans throughout the Americas. The study found that the unique genome or genetic blueprint of Native Americans arose sometime before 25,000 years ago but didn't spread through the Americas until about 15,000 years ago.

"This result indicated that a substantial population existed somewhere, in isolation from the rest of Asia, while its genome differentiated from the parental Asian genome," O'Rourke says. "The researchers suggested Beringia as the location for this isolated population, and suggested it existed there for several thousand years before members of the population migrated southward into the rest of North and, ultimately, South America as retreating glaciers provided routes for southern migration."

"Several other genetic-genomic analyses of Native American populations have resulted in similar conclusions," he adds.

"For a long time, many of us thought the land bridge was a uniform tundra-steppe environment" -- a broad windswept grassland devoid of shrubs and trees, O'Rourke says. But in recent years, sediment cores drilled in the Bering Sea and along the Alaskan coast -- the now-submerged lowlands of Beringia -- found pollens of trees and shrubs.

That "suggests Beringia was not a uniform tundra-steppe environment, but a patchwork of environments, including substantial areas of lowland shrub tundra," O'Rourke says. "These shrub-tundra areas were likely refugia for a population that would be invisible archaeologically, since the former Beringian lowlands are now submerged."

"Large herd animals like bison or mammoths likely lived on the highland steppe tundra because they graze. Many smaller animals, birds, elk and moose (which browse shrubs instead of grazing on grass) would have been in the shrub tundra," he adds.

Other research indicates "that much of Beringia -- particularly the lowlands -- appears to have had average summer temperatures nearly identical (or only slightly cooler in some regions) to those in the region today," O'Rourke says. "The local environments likely were not as daunting as many have assumed for years. They probably hunkered down pretty good in the winter though. It would have been cold."

The idea that rising sea levels covered evidence of human migration to the Americas has long been cited by researchers studying how early Native Americans moved south along the Pacific coast as the glaciers receded and sea levels rose. O'Rourke says the idea hasn't been used before to explain the scarcity of archaeological sites in Alaska and Siberia, which were highlands when the land bridge was exposed.

But O'Rourke and his colleagues say archaeological sites must be found in Beringia if the long human layover there is to be confirmed. Although most such sites are underwater, some evidence of human habitation in shrub tundra might remain above sea level in low-lying portions of Alaska and eastern Chukotka (in Russia)."

Story Source:

The above story is based on materials provided by University of Colorado at Boulder and ScienceDaily, February 27, 2014.

Journal Reference: J. F. Hoffecker, S. A. Elias, D. H. O'Rourke. **Out of Beringia?** *Science*, 2014; 343 (6174): 979 DOI: 10.1126/science.1250768

Million suns shed light on fossilized plant

Scientists have used one of the brightest lights in the Universe to expose the biochemical structure of a 50 million-year-old fossil plant to stunning visual effect.

Optical plus X-ray false color composite image (Cu = red, Zn = green, and Ni =blue) montage of a 50 million year old leaf fossil. Credit: P. wyomingensis, specimen BHI-3113

The team of palaeontologists, geochemists and physicists investigated the chemistry of exceptionally preserved fossil leaves from the Eocene-aged 'Green River Formation' of the western United States by bombarding the fossils with X-rays brighter than a million suns produced by synchrotron particle accelerators.

Researchers from Britain's University of Manchester and Diamond Light Source and the Stanford Synchrotron Radiation Lightsource in the US have published their findings, along with amazing images, in *Metallomics*; one of the images is featured on the cover of the latest edition of the Royal Society of Chemistry journal.

Lead author Dr Nicholas Edwards, a postdoctoral researcher at The University of Manchester, said: "The synchrotron has already shown its potential in teasing new information from fossils, in particular our group's previous work on pigmentation in fossil animals. With this study, we wanted to use the same techniques to see whether we could extract a similar level of biochemical information from a completely different part of the tree of life.

"To do this we needed to test the chemistry of the fossil plants to see if the fossil material was derived directly from the living organisms or degraded and replaced by the fossilisation process.

"We know that plant chemistry can be preserved over hundreds of millions of years -- this preserved chemistry powers our society today in the form of fossil fuels. However, this is just the 'combustible' part; until now no one has completed this type of study of the other biochemical components of fossil plants, such as metals."

By combining the unique capabilities of two synchrotron facilities, the team were able to produce detailed images of where the various elements of the periodic table were located within both living and fossil leaves, as well as being able to show how these elements were combined with other elements.

The work shows that the distribution of copper, zinc and nickel in the fossil leaves was almost identical to that in modern leaves. Each element was concentrated in distinct biological structures, such as the veins and the edges of the leaves, and the way these trace elements and sulphur were attached to other elements was very similar to that seen in modern leaves and plant matter in soils.

Co-author Professor Roy Wogelius, from Manchester's School of Earth, Atmospheric and Environmental Sciences, said: "This type of chemical mapping and the ability to determine the atomic arrangement of biologically important elements, such as copper and sulphur, can only be accomplished by using a synchrotron particle accelerator.

"In one beautiful specimen, the leaf has been partially eaten by prehistoric caterpillars -- just as modern caterpillars feed -- and their feeding tubes are preserved on the leaf. The chemistry of these fossil tubes remarkably still matches that of the leaf on which the caterpillars fed."

The data from a suite of other techniques has led the team to conclude that the chemistry of the fossil leaves is not wholly sourced from the surrounding environment, as has previously been suggested, but represents that of the living leaves. Another modern-day connection suggests a way in which these specimens are so beautifully preserved over millions of years.

Manchester palaeontologist and co-author Dr Phil Manning said: "We think that copper may have aided preservation by acting as a 'natural' biocide, slowing down the usual microbial breakdown that would destroy delicate leaf tissues. This property of copper is used today in the same wood preservatives that you paint on your garden fence before winter approaches."

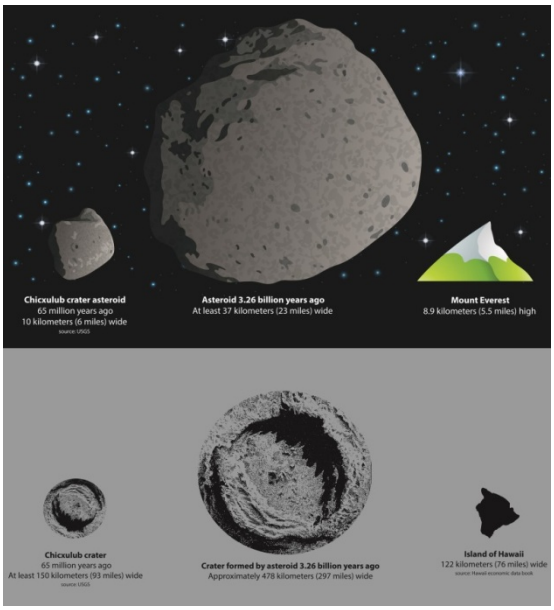
Story Source: The above story is based on materials provided by Manchester University and DailyScience March 25, 2014.

Journal Reference: Nicholas Paul Edwards, Phillip Lars Manning, Uwe Bergmann, Peter Lars Larson, Bart van Dongen, William I Sellers, Samuel M Webb, Dimosthenis Sokaras, Roberto Alonso Mori, Konstantin Ignatyev, Holly E Barden, Arjen van Veelen, Jennifer Anne, Victoria M Egerton, Roy A Wogelius. **Leaf metallome preserved over 50 million years**. *Metallomics*, 2014; DOI: 10.1039/C3MT00242J

Scientists reconstruct ancient impact that dwarfs dinosaur-extinction blast

Picture this: A massive asteroid almost as wide as Rhode Island and about three to five times larger than the rock thought to have wiped out the dinosaurs slams into Earth. The collision punches a crater into the planet's crust that's nearly 500 kilometers (about 300 miles) across: greater than the distance from Washington, D.C. to New York City, and up to two and a half times larger in diameter than the hole formed by the dinosaur-killing asteroid. Seismic waves bigger than any recorded earthquakes shake the planet for about half an hour at any one location -- about six times longer than the huge earthquake that struck Japan three years ago. The impact also sets off tsunamis many times deeper than the one that followed the Japanese quake.

Although scientists had previously hypothesized enormous ancient impacts, much greater than the one that may have eliminated the dinosaurs 65 million years ago, now a new study reveals the power and scale of a cataclysmic event some 3.26 billion years ago which is thought to have created geological features found in a South African region known as the Barberton greenstone belt. The research has been accepted for publication in Geochemistry, Geophysics, Geosystems, a journal of the American Geophysical Union.



A graphical representation of the size of the asteroid thought to have killed the dinosaurs, and the crater it created, compared to an asteroid thought to have hit the Earth 3.26 billion years ago and the size of the crater it may have generated. A new study reveals the power and scale of the event some 3.26 billion years ago which scientists think created geological features found in a South African region known as the Barberton greenstone belt. Credit: Image courtesy of American Geophysical Union

The huge impactor -- between 37 and 58 kilometers (23 to 36 miles) wide -- collided with the planet at 20 kilometers per second (12 miles per second). The jolt, bigger than a 10.8 magnitude earthquake, propelled seismic waves hundreds of kilometers through Earth, breaking rocks and setting off other large earthquakes. Tsunamis thousands of meters deep -- far bigger than recent tsunamis generated by earthquakes -- swept across the oceans that covered most of Earth at that time.

"We knew it was big, but we didn't know how big," Donald Lowe, a geologist at Stanford University and a co-author of the study, said of the asteroid.

Lowe, who discovered telltale rock formations in the Barberton greenstone a decade ago, thought their structure smacked of an asteroid impact. The new research models for the first time how big the asteroid was and the effect it had on the planet, including the possible initiation of a more modern plate tectonic system that is seen in the region, according to Lowe.

The study marks the first time scientists have mapped in this way an impact that occurred more than 3 billion years ago, Lowe added, and is likely one of the first times anyone has modeled any impact that occurred during this period of Earth's evolution.

The impact would have been catastrophic to the surface environment. The smaller, dino-killing asteroid crash is estimated to have released more than a billion times more energy than the bombs that destroyed Hiroshima and Nagasaki. The more ancient hit now coming to light would have released much more energy, experts said.

The sky would have become red hot, the atmosphere would have been filled with dust and the tops of oceans would have boiled, the researchers said. The impact sent vaporized rock into the atmosphere, which encircled the globe and condensed into liquid droplets before solidifying and falling to the surface, according to the researchers.

The impact may have been one of dozens of huge asteroids that scientists think hit Earth during the tail end of the Late Heavy Bombardment period, a major period of impacts that occurred early in Earth's history -- around 3 billion to 4 billion years ago.

Many of the sites where these asteroids landed were destroyed by erosion, movement Earth's crust and other forces as Earth evolved, but geologists have found a handful of areas in South Africa, and Western Australia that still harbor evidence of these impacts that occurred between 3.23 billion and 3.47 billion years ago. The study's co-authors think the asteroid hit Earth thousands of kilometers away from the Barberton Greenstone Belt, although they can't pinpoint the exact location.

"We can't go to the impact sites. In order to better understand how big it was and its effect we need studies like this," said Lowe. Scientists must use the geological evidence of these impacts to piece together what happened to the Earth during this time, he said.

The study's findings have important implications for understanding the early Earth and how the planet formed. The impact may have disrupted Earth's crust and the tectonic regime that characterized the early planet, leading to the start of a more modern plate tectonic system, according to the paper's co-authors.

The pummeling the planet endured was "much larger than any ordinary earthquake," said Norman Sleep, a physicist at Stanford University and co-author of the study. He used physics, models, and knowledge about the formations in the Barberton greenstone belt, other earthquakes and other asteroid impact sites on Earth and the moon to calculate the strength and duration of the shaking that the asteroid produced. Using this information, Sleep recreated how waves traveled from the impact site to the Barberton greenstone belt and caused the geological formations.

The geological evidence found in the Barberton that the paper investigates indicates that the asteroid was "far larger than anything in the last billion years," said Jay Melosh, a professor at Purdue University in West Lafayette, Indiana, who was not involved in the research.

The Barberton greenstone belt is an area 100 kilometers (62 miles) long and 60 kilometers (37 miles) wide that sits east of Johannesburg near the border with Swaziland. It contains some of the oldest rocks on the planet.

The model provides evidence for the rock formations and crustal fractures that scientists have discovered in

the Barberton greenstone belt, said Frank Kyte, a geologist at UCLA who was not involved in the study.

"This is providing significant support for the idea that the impact may have been responsible for this major shift in tectonics," he said.

Reconstructing the asteroid's impact could also help scientists better understand the conditions under which early life on the planet evolved, the paper's authors said. Along with altering Earth itself, the environmental changes triggered by the impact may have wiped out many microscopic organisms living on the developing planet, allowing other organisms to evolve, they said.

"We are trying to understand the forces that shaped our planet early in its evolution and the environments in which life evolved," Lowe said.

Story Source: The above story is based on materials provided by American Geophysical Union and ScienceDaily April 9, 2014.

Journal Reference: Norman H. Sleep, Donald R. Lowe. **Physics of crustal fracturing and chert dike formation triggered by asteroid impact, ~3.26 Ga, Barberton greenstone belt, South Africa**. *Geochemistry, Geophysics, Geosystems*, 2014; DOI: 10.1002/2014GC005229

Goldilocks principle: Earth's continued habitability due to geologic cycles that act as climate control

Researchers from USC and Nanjing University in China have documented evidence suggesting that part of the reason that Earth has become neither sweltering like Venus nor frigid like Mars lies with a built-in atmospheric carbon dioxide regulator -- the geologic cycles that churn up the planet's rocky surface.

Credit: NASA Goddard Space Flight Center

Researchers from USC and Nanjing University in China have documented evidence suggesting that part of the reason that Earth has become neither sweltering like Venus nor frigid like Mars lies with a built-in atmospheric carbon dioxide regulator -- the geologic cycles that churn up the planet's rocky surface.

Scientists have long known that "fresh" rock pushed to the surface via mountain formation effectively acts as a kind of sponge, soaking up the greenhouse gas CO_2. Left unchecked, however, that process would simply deplete atmospheric CO_2 levels to a point that would plunge Earth into an eternal winter within a few million years during the formation of large mountain ranges like the Himalayas -- which has clearly not happened.

And while volcanoes have long been pointed to as a source of carbon dioxide, alone they cannot balance out the excess uptake of carbon dioxide by large mountain ranges. Instead, it turns out that "fresh" rock exposed by uplift also emits carbon through a chemical weathering process, which replenishes the atmospheric carbon dioxide at a comparable rate.

"Our presence on Earth is dependent upon this carbon cycle. This is why life is able to survive," said Mark Torres, lead author of a study disclosing the findings that appears in *Nature* on March 20. Torres, a doctoral fellow at the USC Dornsife College of Letters, Arts and Sciences, and a fellow at the Center for Dark Energy Biosphere Investigations (C-DEBI), collaborated with Joshua West, professor of Earth Sciences at USC Dornsife, and Gaojun Li of Nanjing University in China.

While human-made atmospheric carbon dioxide increases are currently driving significant changes in Earth's climate, the geologic system has kept things balanced for million of years.

"The Earth is a bit like a big, natural recycler," West said. Torres and West studied rocks taken from the Andes mountain range in Peru and found that weathering processes affecting rocks released far more carbon than previously estimated, which motivated them to consider the global implications of CO_2 release during mountain formation.

The researchers noted that rapid erosion in the Andes unearths abundant pyrite -- the shiny mineral known as "fool's gold" because of its deceptive appearance -- and its chemical breakdown produces acids that release CO_2 from other minerals. These observations motivated them to consider the global implications of CO_2 release during mountain formation.

Like many other large mountain ranges, such as the great Himalayas, the Andes began to form during the Cenozoic period, which began about 60 million years ago and happened to coincide with a major perturbation in the cycling of atmospheric carbon dioxide. Using marine records of the long-term carbon cycle, Torres, West, and Li reconstructed the balance between CO_2

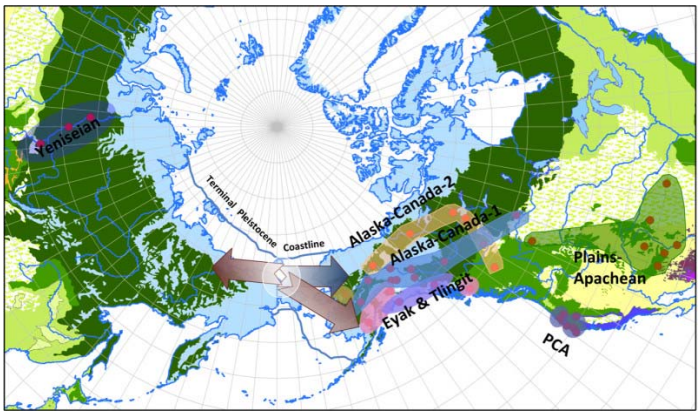
release and uptake caused by the uplift of large mountain ranges and found that the release of CO_2 release by rock weathering may have played a large, but thus far unrecognized, role in regulating the concentration of atmospheric carbon dioxide over the last roughly 60 million years.

Story Source: The above story is based on materials provided by University of Southern California and ScienceDaily, March 19, 2014. The original article was written by Robert Perkins.

Journal Reference: Mark A. Torres, A. Joshua West, Gaojun Li. **Sulphide oxidation and carbonate dissolution as a source of CO2 over geological timescales**. *Nature*, 2014; 507 (7492): 346 DOI: 10.1038/nature13030

Language 'evolution' may shed light on human migration out-of-Beringia: Relationship between Siberian, North American languages

Evolutionary analysis applied to the relationship between North American and Central Siberian languages may indicate that people moved out from the Bering Land Bridge, with some migrating back to central Asia and others into North America, according to a paper published in the open-access journal *PLOS ONE* on March 12, 2014 by Mark Sicoli, from Georgetown University and Gary Holton from University of Alaska Fairbanks.



This polar projection map of Asia and North America shows the approximate terminal Pleistocene shoreline. The center of geographic distribution of Yeniseian and Na-Dene language is in Beringia. From this center burgundy arrows extend toward the North American coast and into Siberia. A blue arrow indicates Interior dispersals of Na-Dene. Credit: Mark A. Sicoli; doi:10.1371/journal.pone.0091722.g004; CC-BY

Languages evolve slowly overtime and may even follow human migratory patterns. A proposed language family known as the Dené-Yeniseian suggests that there are common language elements between the North American Na-Dene languages and the Yeniseian languages of Central Siberia. To investigate this further, scientists employed a technique originally developed to investigate evolutionary relationships between biological species called phylogenetic analysis, where a tree is constructed to represent relationships of common ancestry based on shared traits. Scientists used linguistic phylogeny to work out how approximately 40 languages from the area diffused across North America and Asia. The authors first coded a linguistic dataset from the languages, modeled the relationship between the data, and then modeled it against migration patterns from Asia to North America, or out-of-Beringia.

Results show an early dispersal of Na-Dene along the North American coast with a Yeniseian back migration through Siberia and a later dispersal of North American interior Na-Dene languages. Sicoli explained, "we used computational phylogenetic methods to impose constraints on possible family tree relationships modeling both an Out-of-Beringia hypothesis and an Out-of-Asia hypothesis and tested these against the linguistic data. We found substantial support for the out-of-Beringia dispersal adding to a growing body of evidence for an ancestral population in Beringia before the land bridge was inundated by rising sea levels at the end of the last ice age."Although the authors cannot conclusively determine the migration pattern just from these results, and state that this study does not necessarily contradict the popular tale of hunters entering the New World through Beringia, it at the very least indicates that migration may not have been a one-way trip. This work also helps demonstrate the usefulness of evolutionary modeling with linguistic trees for investigating these types of questions.

These finding suggest that phylogenetics may be used to explore the implications of deep linguistic relationships.

Story Source: The above story is based on materials provided by PLOS and ScienceDaily, March 12, 2014

Journal Reference: Mark A. Sicoli, Gary Holton. **Linguistic Phylogenies Support Back-Migration from Beringia to Asia**. *PLoS ONE*, 2014; 9 (3): e91722 DOI: 10.1371/journal.pone.0091722

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NCGS FIELD TRIP
Saturday May 3, 2014

"ANCIENT SUBMARINE LANDSLIDES IN A SUBMARINE CANYON FILL – THE CARMELO FORMATION AT POINT LOBOS"

Leader: Dr. Edward Clifton, US Geological Survey, Geologist Emeritus

The Carmelo Formation at Point Lobos State Reserve is a superbly exposed example of conglomerate and sandstone deposited in an early Paleogene submarine canyon. This field trip focuses on an aspect of the canyon that has been largely fill that has been largely overlooked: the influence of large submarine landslides. Too large to be readily seen in outcrop, mass failures in the Carmelo explain many of its anomalous structural and sedimentologic features. The field trip will focus on the evidence for these features and their impact on the canyon fill. We will examine evidence for large-scale exhumation of the canyon that was possibly caused by a massive slide of the canyon fill. We will explore the baffling contact with the underlying granodiorite in the southern part of the Reserve and the possibility that it resulted from a massive slide. We will see how a large slide disrupted a thick succession of canyon fill and the possible impact on strata far removed from the slide. We will consider the possibility that none of the strata exposed on the South Shore of the Reserve is in place.

Please carpool share the ride and cost. We will circulate attendees list for carpooling to the meeting place. No. geologic hammers please.

THIS FIELD TRIP WILL BE LIMITED TO 30 PEOPLE.

********** **Field Trip Logistics in preparation**********

Time & Meeting Place: May 3, 2014, 8:45 am at the Reserve entrances
Cost: $30/person includes guidebook, contribution to the Reserve; morning coffee, muffins, lunch, refreshments. No more plastic water bottle, bring your own water bottle

**********REGISTRATION FORM (Pt. Lobos Field Trip) **********

Name:_____ E-mail:_____

Carpool origin Residence:_____ Phone: ____ _____ Phone (alternate):_____

Check no./amount _____ Please indicate if you want drive a car and the # of people ride share

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

Please mail registration with a check payable to NCGS:

Tridib Guha
5016 Gloucester Lane
Martinez, CA 94553

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

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NCGS DINNER MEETING Wednesday May 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) **********

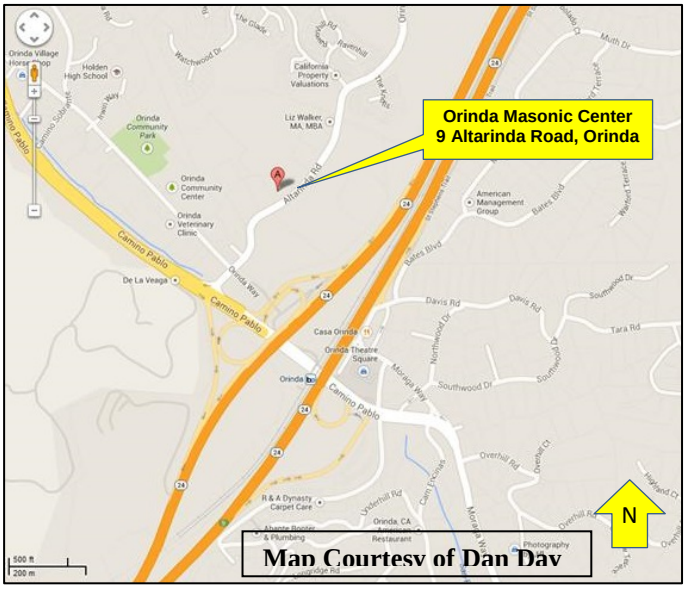
Name:_____ E-mail:_____

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
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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.