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MEETING ANNOUNCEMENT

DATE: **April 27, 2016**

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. Ronald Olowin, Department of Physics and Astronomy, Saint Mary's College**

Topic: Dark Matter and the Universe

"If it ain't Dark, then it don't Matter."
A look at the mysterious stuff that
comprises most of the Universe,
and exo-Geology: the plurality of worlds.

Biography: Professor Ronald P. Olowin joined the Saint Mary's College community in 1987 and is a full professor in the Department of Physics and Astronomy. Though trained in observational cosmology where he studies the Large-Scale Structure of the universe by a detailed mapping of nearby clusters of galaxies, his varied interests span a variety of topics from Archeo- and Ethno-Astronomy, Science and the Arts, to aspects of the Science and Religion dialog. Dr. Olowin is a member of the Center for Theology and the Natural Sciences at Berkeley and also a Visiting Scholar at the Graduate Theological Union, also at Berkeley. He is a member of the International Organizing Board of the Science Sectariat of the International Federation of Catholic Universities (IFCU); Chair of the International Executive Committee of the Inspiration of Astronomical Phenomena (INSAP); and past-President of the Robinson Jeffers (Poetry) Association. Professor Olowin is the author of over 40 articles in scientific journals and popular publications and is an internationally recognized scholar who has delivered papers in over a dozen countries and observed the heavens from all parts of the globe using some of the world's largest instruments.

NCGS 2015 – 2016 Calendar

May 25, 2016 6:00 pm (dinner meeting; submit flyer on Page 11 to reserve your seats!)
Dr. Charles K. Paull, Monterey Bay Aquarium Research Institute
Sediment Movement through Monterey and other Submarine Canyons along the California Coast

June 22, 2016 7:00 pm
Jerome V. De Graff, CSU Fresno, Richard H. Jahns Lecturer for 2016 by the Association of Environmental & Engineering Geologists and the Geological Society of America
Fire, Earth & Rain

NCGS Field Trips

Field trips in a preliminary planning stage:

- Geology of Devil's Slide
- Pt. Sal Ophiolite in Santa Barbara Co,
- Convergent Margin Tectonics across Central California Coast Ranges - Pacheco Pass
- Tuscan Formation volcanic mudflow deposits, Cascade foothills

Peninsula Geologic Society

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.

UC Berkeley Earth & Planetary Science Weekly Seminar Series

Interesting seminars are presented weekly at EPS throughout the academic year. An upcoming seminar of possible interest will be held Thursday, April 21 at 4 pm at 141 McCone, when Lynn Ingram of UC Berkeley will speak on the topic "**California Climate Extremes: What the Paleoclimate Record Tells Us about a Warmer Future**"

For an updated list of seminars, go to http://eps.berkeley.edu/events/seminars.

Columns at Crowley Lake

NCGS Outreach Chair John Christian forwarded a blog posting he came across recently by a pair of retired educators who tell about the outstanding places they visit. They recently journeyed to the eastern Sierra and the Owens Valley. In Bishop they went first to the Interagency Visitors Center, where they got a tip about the strange columns and caves along the southeastern shores of Crowley Lake near Mammoth Lakes. They accessed the area with a 4-wheel-drive vehicle, but it's also accessible by boat or by foot. It appears that the columns and caves were developed in the thick deposits of the Bishop Tuff that originated in the Long Valley Caldera eruption of 760,000 years b.p. They were exposed only after the Crowley Reservoir was created in 1941, when wave action eroded away softer material (water levels have since receded). Recent research into the origins of the columns was presented by a UC Berkeley team at the 2015 American Geophysical Union conference in San Francisco, and is summarized in an article in the Los Angeles Times.

The above photographs were taken by the travelers mentioned above, and appear with many other fine pictures in their blog posting at https://ohtheplacestheygo.wordpress.com/2015/10/15/crowley-lake-columns/

The newspaper article summarizing the research team's findings can be found at

http://www.latimes.com/science/la-me-adv-volcanic-columns-mystery-20151115-story.html

A Reminder: *It's Past Renewal Time!* Our Year Runs From September to September. If you haven't already renewed, please use the Renewal Form included as Page 11 of the Newsletter.

Detailed Mapping and Rupture Implications of the 1 km Releasing Bend in the Rodgers Creek Fault at Santa Rosa, Northern California

S. Hecker. V.E. Langenheim, R.A. Williams, C.S. Hitchcock, and S.B. DeLong

(Abstract published online by Bulletin of the Seismological Society of America, April 2016, vol. 106, no. 2, p. 575-594)

Airborne light detection and ranging (lidar) topography reveals for the first time the trace of the Rodgers Creek fault (RCF) through the center of Santa Rosa, the largest city in the northern San Francisco Bay area. Vertical deformation of the Santa Rosa Creek floodplain expresses a composite pull-apart basin beneath the urban cover that is part of a broader 1-km-wide right-releasing bend in the fault. High-resolution geophysical data illuminate subsurface conditions that may be responsible for the complex pattern of surface faulting, as well as for the distribution of seismicity and possibly for creep behavior. We identify a dense, magnetic basement body bounded by the RCF beneath Santa Rosa that we interpret as a strong asperity, likely part of a larger locked patch of the fault to the south. A local increase in frictional resistance associated with the basement body appears to explain (1) distributed fault-normal extension above where the RCF intersects the body; (2) earthquake activity around the northern end of the body, notably the 1969 M_L 5.6 and 5.7 events and aftershocks; and (3) creep rates on the RCF that are higher to the north of Santa Rosa than to the south. There is a significant probability of a major earthquake on the RCF in the coming decades, and earthquakes associated with the proposed asperity have the potential to release seismic energy into the Cotati basin beneath Santa Rosa, already known from damaging historical earthquakes to produce amplified ground shaking.

Trickle of food' helped deep-sea creatures survive asteroid strike that wiped out the dinosaurs

Artist's impression of large asteroid closing in on Earth (stock image).
Credit: © Mopic / Fotolia

A team led by experts at Cardiff University has provided new evidence to explain why deep-sea creatures were able to survive the catastrophic asteroid strike that wiped out the dinosaurs 65m years ago.

Like the dinosaurs themselves, giant marine reptiles, invertebrates and microscopic organisms became extinct after the catastrophic asteroid impact in an immense upheaval of the world's oceans, yet deep-sea creatures managed to survive.

This has puzzled researchers as it is widely believed that the asteroid impact cut off the food supply in the oceans by destroying free-floating algae and bacteria.

However, in a study published in the April issue of the journal *Geology*, a team led by researchers from Cardiff University's School of Earth and Ocean Sciences provides strong evidence suggesting that some forms of algae and bacteria were actually living in the aftermath of the asteroid disaster, and that they acted as a constant, sinking, slow trickle of food for creatures living near the seafloor.

The team were able to draw these conclusions by analyzing new data from the chemical composition of the fossilized shells of sea surface and seafloor organisms from that period, taken from drilling cores from the ocean floor in the South Atlantic.

This gave the researchers an idea of the flux, or movement, of organic matter from the sea surface to the seafloor in the aftermath of the asteroid strike, and led them to conclude that a slow trickle of food was constantly being delivered to the deep ocean.

Furthermore, the team were able to calculate that the food supply in the ocean was fully restored around 1.7m years after the asteroid strike, which is almost half the original estimates, showing that marine food chains bounced back quicker than originally thought.

Heather Birch, a Cardiff University PhD from the School of Earth and Ocean Sciences who led the study, said: "The global catastrophe that caused the extinction of the dinosaurs also devastated ocean ecosystems. Giant marine reptiles met their end as did various types of invertebrates such as the iconic ammonites.

"Our results show that despite a wave of massive and virtually instantaneous extinctions among the plankton, some types of photosynthesizing organisms, such as algae and bacteria, were living in the aftermath of the asteroid strike.

"This provided a slow trickle of food for organisms living near the ocean floor which enabled them to survive the mass extinction, answering one of the outstanding questions that still remained regarding this period of history.

"Even so, it took almost two million years before the deep sea food supply was fully restored as new species evolved to occupy ecological niches vacated by extinct forms."

Many scientists currently believe that the mass extinction of life on Earth around 65m years ago was caused by a 110km-wide asteroid that hit Mexico's Yucatán Peninsula. It is believed the debris from impact starved Earth of the Sun's energy and, once settled, led to greenhouse gases locking in the Sun's heat and causing temperatures to rise drastically.

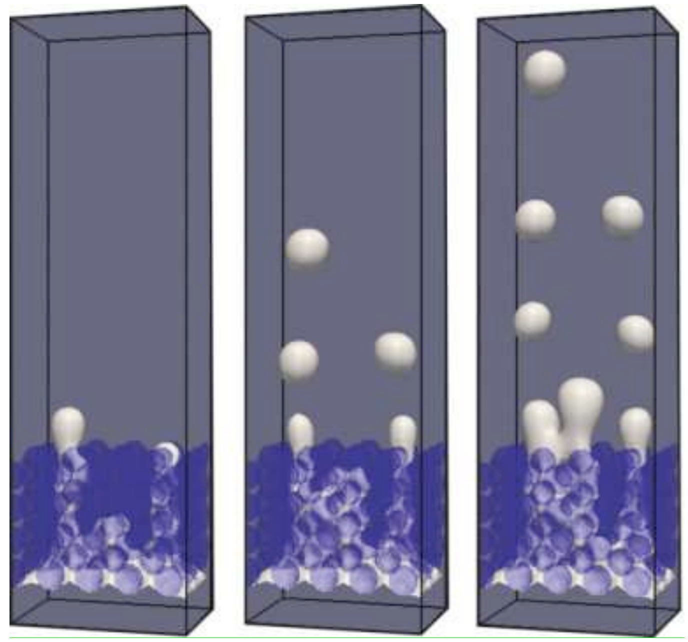
This period of darkness followed by soaring heat, known as the Cretaceous-Paleogene boundary, was thought to obliterate almost half of the world's species.

Scientists also claim that the impact of the asteroid would have filled Earth's atmosphere with sulfur trioxide, subsequently creating a gas cloud that would have caused a mass amount of sulfuric acid rain to fall in just a few days, making the surface of the ocean too acidic for upper ocean creatures to live.

Story Source: The above post is reprinted from materials provided by Cardiff University.

Journal Reference: Heather S. Birch, Helen K. Coxall, Paul N. Pearson, Dick Kroon, Daniela N. Schmidt. **Partial collapse of the marine carbon pump after the Cretaceous-Paleogene boundary**. *Geology*, 2016; 44 (4): 287 DOI: 10.1130/G37581.1.

Volcanic eruptions: How bubbles lead to disaster



Simulation of buoyant bubbles in crystal-rich magma (blue layer) and in an crystal-poor melt (top layer).

Credit: Graphics: Andrea Parmigiani / ETH Zurich

In 1816, summer failed to make an appearance in central Europe and people were starving. Just a year earlier, the Tambora volcano had erupted in Indonesia, spewing huge amounts of ash and sulfur into the atmosphere. As these particles partly blocked sunlight, cooling the climate, it had a serious impact on the land and the people, even in Switzerland.

Since then, volcanologists have developed more precise ideas of why super-volcanoes such as Tambora are not only highly explosive but also why they release so much sulfur into the atmosphere.

Gas bubbles tend to accumulate in the upper layers of magma reservoirs, which are only a few kilometers beneath the earth's surface, building up pressure that can then be abruptly liberated by eruption. These bubbles mainly contain water vapor but also sulfur.

Sulfur-rich eruptions

"Such volcanic eruptions can be extremely powerful and spew an enormous amount of ash and sulfur to the surface," says Andrea Parmigiani, a post-doc in the Institute of Geochemistry and Petrology at ETH Zurich. "We've known for some time that gas bubbles play a major role in such events, but we had only been able to speculate on how they accumulate in magma reservoirs."

Together with other scientists from ETH Zurich and Georgia Institute of Technology (Georgia Tech), the researchers studied the behavior of bubbles with a computer model.

The scientists used theoretical calculations and laboratory experiments to examine in particular how bubbles in crystal-rich and crystal-poor layers of magma reservoirs move buoyantly upward. In many volcanic systems, the magma reservoir consists mainly of two zones: an upper layer consisting of viscous melt with almost no crystals, and a lower layer rich in crystals, but still containing pore space.

Super bubbles meander through a maze

When Andrea Parmigiani, Christian Huber and Olivier Bachmann started this project, they thought that the bubbles, as they moved upwards through crystal-rich areas of the magma reservoirs, would dramatically slow down, while they would go faster in the crystal-poor zones.

"Instead, we found that, under volatile-rich conditions, they would ascend much faster in the crystal-rich zones, and accumulate in the melt-rich portions above" says Parmigiani.

Parmigiani explains this as follows: when the proportion of bubbles in the pore space of the crystal-rich layers increases, small individual bubbles coalesce into finger-like channels, displacing the existing highly viscous melt. These finger-like channels allow for a higher vertical gas velocity. The bubbles, however, have to fill at least 10 to 15 % of the pore space.

"If the vapor phase cannot form these channels, individual bubbles are mechanically trapped," says the earth scientist. As these finger-like channels reach the boundary of the crystal-poor melt, individual, more spherical bubbles detach, and continue their ascent towards the surface. However, the more bubble, the more reduce their migration velocity is.

This is because each bubble creates a return flow of viscous melt around it. When an adjacent bubble feels this return flow, it is slowed down. This process was demonstrated in a laboratory experiment conducted by Parmigiani's colleagues Salah Faroughi and Christian Huber at Georgia Tech, using water bubbles in a viscous silicone solution.

"Through this mechanism, a large number of gas bubbles can accumulate in the crystal-poor melt under the roof of the magma reservoir. This eventually leads to overpressurization of the reservoir," says lead author Parmigiani. And because the bubbles also contain sulfur, this also accumulates, explaining why such a volcano might emit more sulfur than expected based on its composition.

What this means for the explosivity of a given volcano is still unclear. "This study focuses primarily on understanding the basic principles of gas flow in magma reservoirs; a direct application to prediction of volcanic behavior remains a question for the future," says the researcher, adding that existing computer models do not depict the entire magma reservoir, but only a tiny part of it: roughly a square of a few cubic centimeter with a clear boundary between the crystal-poor and crystal-rich layers.

To calculate this small volume, Parmigiani used high-performance computers such as the Euler Cluster at ETH Zurich and a supercomputer at the Swiss National Supercomputing Centre in Lugano.

For the software, the researcher had access to the open-source library Palabos, which he continues to develop in collaboration with researchers from University of Geneva. "This software is particularly suitable for this type of simulation," says the physicist.

Story Source: The above post is reprinted from materials provided by ETH Zurich. The original item was written by Peter Rüegg.

Journal Reference: A. Parmigiani, S. Faroughi, C. Huber, O. Bachmann, Y. Su. **Bubble accumulation and its role in the evolution of magma reservoirs in the upper crust**. *Nature*, 2016; DOI: 10.1038/nature17401.

Links within two supercontinents

A new article has apparently solved an age-old riddle of how constituent continents were arranged in two Precambrian supercontinents -- then known as Nuna-Columbia and Rodinia. It's a finding that may have future economic implications for mining companies

Kevin Chamberlain, a research professor in the UW Department of Geology and Geophysics, is co-author of a paper that appears online in Nature Geoscience today (April 11). The paper highlights a technique that he helped develop to test pre-Pangea continental reconstructions. Here, Chamberlain poses with a mass spectrometer and holds a piece of a mafic dike, or black rock, which cuts through white, or granitic, rock (also pictured) that represents continental crust. *Credit: University of Wyoming*

A University of Wyoming researcher contributed to a paper that has apparently solved an age-old riddle of how constituent continents were arranged in two Precambrian supercontinents -- then known as Nuna-Columbia and Rodinia. It's a finding that may have future economic implications for mining companies.

Specifically, the article describes a technique Kevin Chamberlain, a UW research professor in the Department of Geology and Geophysics, and other researchers used to test reconstructions of ancient continents. The paper argues that the rocks or crust now exposed in southern Siberia were once connected to northern North America for nearly a quarter of the Earth's history. Those two continental blocks now form the cores of the modern continents of Asia and North America.

Chamberlain was co-author of the paper, titled "Long-Lived Connection between Southern Siberia and Northern Laurentia in the Proterozoic," that appeared in today's (April 11) online issue of *Nature Geoscience*. The monthly multi-disciplinary journal focuses on bringing together top-quality research across the entire spectrum of the Earth sciences, along with relevant work in related areas. The journal's content reflects all the disciplines within the geosciences, encompassing field work, modeling and theoretical studies.

"The article highlights a technique that our project has been using to test pre-Pangea or ancient continental reconstructions," Chamberlain says. "We have been using the ages, orientations and paleo-magnetic characteristics of short-lived (1 million to 10 million years in duration) igneous, mafic dike swarms as piercing points to determine nearest-neighbor continents in the past."

Mafic dikes are dark-colored rocks or minerals that are in a dike formation, which is a sheet of rock that formed in a fracture in a pre-existing rock body. Chamberlain says mafic dikes, like those studied in the paper, can be found in Wyoming. Mafic dikes in the state include the black vein that can be seen in Mount Moran in the Teton Range; the black, horizontal band on the east face of Medicine Bow Peak; and those that crisscross the Granitic Mountains in central Wyoming.

Using labs at UW and UCLA, Chamberlain says his role in the project was to determine the magmatic ages of numerous mafic dikes through uranium-lead radiometric dating. He was one of four geochronology labs on the team and the only one based in the United States.

The linear dikes from these igneous events (large igneous provinces, or LIPs) are relatively narrow, roughly 100 meters or less, but can be 1,000 to 1,500 kilometers in length. They erupt in a radial pattern. During later rifting, the continents broke into fragments, which later combined into subsequent new continents, such as our modern-day seven continents.

"There may have been four or five cycles of supercontinent formation," Chamberlain says.

Each continental fragment preserves a dike swarm record, he explains. By comparing the temporal records called bar codes (since a plot of dike date vs. time looks like a bar code) of older fragments known as cratons (the cores of modern continents), Chamberlain says he was able to test whether the cratons were close enough to share LIP dike swarms. He adds the research team also can determine when the two cratons joined, as well as when they split apart.

"In this new study, we believe that northern Laurentia (North America) and southern Siberia were joined for nearly 1.2 billion years from 1.9 billion years ago to 700 million years ago," he says. "Geologists are like detectives. It seems like we come to the crime scene after the fact and put together the pieces."

This finding disproves previous constructions of Nuna-Columbia and Rodinia, and establishes new arrangements of the continental blocks within them, he says.

The project determined the ages of nearly 250 mafic dikes worldwide, a number Chamberlain says is large enough to build a database comparison between all of the older continental fragments from roughly 500 million years ago to 2,700 million years ago. The research group also worked on more recent LIPs -- about 400 million to 100 million years ago -- which have importance for oil and gas exploration, and hydrocarbon maturation models.

A consortium of mining companies funded the research project for five years. Their reasoning: That the continental reconstructions for times when major, known metal deposits formed would be useful for prospecting new finds on the conjugate continents, Chamberlain says. These new deposits may be buried under hundreds of meters of younger rock. So, by establishing which continents were next to the known deposits when they formed, the hope is that additional minerals may be found in the future.

"A lot of the major metal deposits in the earth formed in the early part of Earth's history," Chamberlain says.

Story Source: The above post is reprinted from materials provided by University of Wyoming.

Journal Reference: R. E. Ernst, M. A. Hamilton, U. Söderlund, J. A. Hanes, D. P. Gladkochub, A. V. Okrugin, T. Kolotilina, A. S. Mekhonoshin, W. Bleeker, A. N. LeCheminant, K. L. Buchan, K. R. Chamberlain, A. N. Didenko. **Long-lived connection between southern Siberia and northern Laurentia in the**

Proterozoic. *Nature Geoscience*, 2016; DOI: 10.1038/ngeo2700.

Early Earth may have been ice cold

Most researchers believe that Earth's climatic conditions were hot at 3.5 Ga. New findings in South Africa create a new theory, presenting a much colder climate than previously suggested.
Credit: Harald Furnes

When Earth's first organisms were formed, it may have been in an ice cold ocean. New research, published in Science Advances, indicates that both land and ocean were much colder than previously believed.

Many researchers believe that Earth's early oceans were very hot, reaching 80° Celsius, and that life originated in these conditions. New findings may prove the opposite to be true. Harald Furnes, Professor Emeritus at the Department of Earth Science, has analysed volcanic and sedimentary rocks in the Barberton Greenstone Belt, South Africa. The volcanic rocks were deposited at depths of 2 to 4 kilometres.

"We have found evidence that the climate 3.5 billion years ago was a cold environment," says Furnes. Along with Professor Maarten de Wit from Nelson Mandela Metropolitan University, South Africa, Furnes has published the results in the journal Science Advances.

A cold globe

The rocks analysed by Furnes and de Wit were formed at latitudes comparable with that of the Canary Islands. Some of the sedimentary rocks associated with the volcanic rocks, show a remarkable resemblance to those known from more recent ice ages. "This may indicate that Earth, 3.5 billion years ago, experienced an extensive, perhaps global, ice age," Furnes says.

Past ocean temperatures are measured by analysing the relations between oxygen isotopes in rocks known as "chert," a rock composed of pure silicon dioxide. These South African rocks have been exposed to high temperatures. Even so, this is related to hydrothermal activity, or springs of extremely hot water, pumped from the ocean bed.

Similar to present climate

Additionally, the researchers found more proof indicating that these rocks had been exposed to cold water. By examining finely grained sedimentary rocks (originally a claylike mud), that exists along with the deep-submarine volcanic rocks, the researchers found gypsum. Gypsum is produced under high pressure and at very cold temperatures, as in the present deep ocean.

"In other words, we have found independant lines of evidence that the climate conditions at this time may have been quite similar to the conditions we have today," says Furnes.

Furnes thinks some researchers may have difficulties accepting the new knowledge of an early, cold Earth. A paradigm shift in Earth Science is not to be expected, but he thinks the climate of the early earth will be seen in a new light. "I think that this will force research to go further," he says.

Story Source: The above post is reprinted form materials provided by University of Bergen. The original item was written by Jens Helleland Ådnanes.

Journal Reference: M. J. de Wit, H. Furnes. **3.5-Ga hydrothermal fields and diamictites in the Barberton Greenstone Belt--Paleoarchean crust in cold environments**. Science Advances, 2016; 2 (2): e1500368 DOI: 10.1126/sciadv.1500368.

Earth's internal heat drives rapid ice flow, subglacial melting in Greenland

A glacier in Greenland (stock image). Secrets of Greenland's past have been hidden by the 3 km thick ice sheet covering the landmass and are now revealed by the researchers using an innovative combination of computer models and data sets from seismology, gravity measurements, ice core drilling campaigns, radar sounding, as well as both airborne, satellite and ground-

based measurements on the thickness of the ice cover. Credit: © the_lightwriter / Fotolia

To understand Greenland's ice of today researchers have to go far back into Earth's history. The island's lithosphere has hot depths which originate in its distant geological past and cause Greenland's ice to rapidly flow and melt from below. An anomaly zone crosses Greenland from west to east where present-day flow of heat from Earth's interior is elevated. With this anomaly, an international team of geoscientists led by Irina Rogozhina and Alexey Petrunin from the GFZ German Research Centre for Geosciences could explain observations from radar and ice core drilling data that indicate a widespread melting beneath the ice sheet and increased sliding at the base of the ice that drives the rapid ice flow over a distance of 750 kilometers from the summit area of the Greenland ice sheet to the North Atlantic Ocean.

The North Atlantic Ocean is an area of active plate tectonics. Between 80 and 35 million years ago tectonic processes moved Greenland over an area of abnormally hot mantle material that still today is responsible for the volcanic activity of Iceland. The mantle material heated and thinned Greenland at depth producing a strong geothermal anomaly that spans a quarter of the land area of Greenland. This ancient and long-lived source of heat has created a region where subglacial meltwater is abundant, lubricating the base of the ice and making it flow rapidly. The study indicates that about a half of the ice in north-central Greenland is resting on a thawed bed and that the meltwater is routed to the ocean through a dense hydrological network beneath the ice.

The team of geoscientists has now, for the first time, been able to prove strong coupling between processes deep in Earth's interior with the flow dynamics and subglacial hydrology of large ice sheets: "The geothermal anomaly which resulted from the Icelandic mantle-plume tens of millions of years ago is an important motor for today's hydrology under the ice sheet and for the high flow-rate of the ice," explains Irina Rogozhina. "This, in turn, broadly influences the dynamic behavior of ice masses and must be included in studies of the future response to climate change."

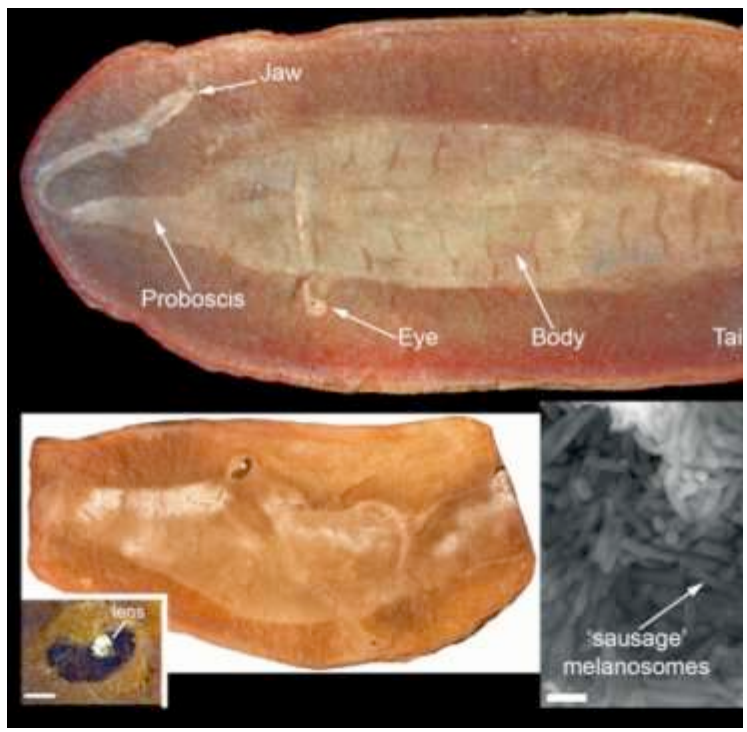
These secrets of Greenland's past have been hidden by the 3 km thick ice sheet covering the landmass and are now revealed by the researchers using an innovative combination of computer models and data sets from seismology, gravity measurements, ice core drilling campaigns, radar sounding, as well as both airborne, satellite and ground-based measurements on the thickness of the ice cover. The location and orientation of the zone of elevated geothermal heat flow shows where Greenland moved over the Iceland mantle plume.

This unexpected link between hotspot history and ice sheet behavior shows that the influences on ice sheets span a huge range of timescales from the month by month changes of the ice cover to the multi-million year epochs over which Earth's mantle and tectonic plates evolve. Besides this, the results of the study provide an independent test for models of the opening of the North Atlantic which after a three-decade-long debate still is not fully understood.

Story Source: The above post is reprinted from materials provided by Helmholtz Center Potsdam – GFZ German Research Center for Geosciences.

Journal Reference: Irina Rogozhina, Alexey G. Petrunin, Alan P. M. Vaughan, Bernhard Steinberger, Jesse V. Johnson, Mikhail K. Kaban, Reinhard Calov, Florian Rickers, Maik Thomas, Ivan Koulakov. **Melting at the base of the Greenland ice sheet explained by Iceland hotspot history**. Nature Geoscience, 2016; DOI: 10.1038/NGO2689.

Prehistoric peepers give vital clue in solving 300-million-year-old 'Tully Monster'



This is an image of the 'Tully Monster' fossil and 'meatball' and 'sausage' melanosomes. *Credit: University of Leicester*

A 300-million-year-old fossil mystery has been solved by a research team led by the University of Leicester, which has identified that the ancient 'Tully Monster' was a vertebrate -- due to the unique characteristics of its eyes. Tullimonstrum gregarium or as it is more commonly known the 'Tully Monster', found only in coal quarries in Illinois, Northern America, is known to many Americans because its alien-like image can be seen on the sides of large U-haul™ trailers which ply the freeways.

Despite being an iconic image -- a fossil with a striped body, large tail, a pair of stalks terminating in dark, oval-shaped 'blobs' and a large elephant trunk-like proboscis at the head end which has a pincer-like claw filled with teeth -- it is a complete mystery as to what kind of extinct animal it was.

Professor Sarah Gabbott from the University of Leicester's Department of Geology said: "Since its discovery over 60 years ago scientists have suggested it is a whole parade of completely different creatures ranging from molluscs to worms -- but there was no conclusive evidence and so speculation continued."

Thomas Clements, a PhD student from the University of Leicester and lead author on the paper, explained: "When a fossil has anatomy this bizarre it's difficult to know where to start, so we decided to look at the most striking feature -- the stalked structures with dark blobs."

This proved to be the vital clue the team needed to solve the mystery.

In a new study published in *Nature*, the University of Leicester palaeontologists, along with colleagues at the University of Bristol and the University of Texas in Austin, discovered that the dark 'blobs' were actually made up of hundreds of thousands of microscopic dark granules, each 50 times smaller than the width of a human hair.

The shape and chemical composition of these granules is identical to organelles found in cells called melanosomes; these being responsible for creating and storing the pigment melanin.

Dr Jakob Vinther (University of Bristol) said: "We used a new technique called Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS) to identify the chemical signature of the fossil granules and compared it to known modern melanin from crows and this proved that we had discovered the oldest fossil pigment currently known."

Thomas added: "Nearly all animals can produce the pigment melanin. It's what gives humans the range of skin and hair colours we see today. Melanin is also found in the eyes of many animal groups where it stops light from bouncing around inside the eyeball and allows the formation of a clear visual image."

Identifying fossil melanosomes containing melanin and a lens is the first time it has been conclusively proved that Tullimonstrum had eyes on stalks.

When the team looked closer at the melanosomes they made another exciting discovery. Professor Gabbott said: "There were two distinct shapes of melanosomes in Tullimonstrum's eyes: some look like microscopic 'sausages' and others like microscopic 'meatballs'. This evidence was crucial because only vertebrates have two different shapes of melanosome, meaning that unlike previous researchers that thought that Tullimonstrum was an invertebrate (animal without a backbone), this is the first unequivocal evidence that Tullimonstrum is a member of the same group of animals as us, the vertebrates."

Thomas added: "This is an exciting study because not have we discovered the oldest fossil pigment, but the structures seen in Tullimonstrum's eyes suggest it had good vision. The large tail and teeth suggest that the Tully Monster is in fact a type of very weird fish."

Story Source: The above post is reprinted from materials provided by University of Leicester.

Journal Reference: Thomas Clements, Andrei Dolocan, Peter Martin, Mark A. Purnell, Jakob Vinther, Sarah E. Gabbott. The eyes of Tullimonstrum reveal a vertebrate affinity. *Nature*, 2016; DOI: 10.1038/nature17647.

Chemical weathering controls erosion rates in rivers

A bedrock-floored streambed after a recent flow event in Kohala Peninsula. *Credit: Brendan Murphy*

Chemical weathering can control how susceptible bedrock in river beds is to erosion, according to new research. In addition to explaining how climate can influence landscape erosion rates, the results also may improve scientists' ability to interpret and predict feedbacks between erosion, plate tectonics and Earth's climate.

The research, led by The University of Texas at Austin, was published in *Nature* on April 14, 2016.

"Our research presents a specific, process-based mechanism to explain how and why river erosion depends on climate, and also perhaps why previous studies have found conflicting sensitivities to climate in different landscapes," said Brendan Murphy, a Ph.D. student at The University of Texas Jackson School of Geosciences who led the research.

Murphy conducted the research with Joel Johnson, a professor in the Jackson School's Department of Geological Sciences, Nicole Gasparini of Tulane University and Leonard Sklar of San Francisco State University.

Chemical weathering occurs when minerals in rock react with water. These chemical reactions physically weaken rock by altering its structure. Rocks in streambeds then become more susceptible to erosion by physical processes, such as impacts by sediment carried in flowing water.

It has been established that chemical weathering influences rock strength, Murphy said. But scientists have lacked data on the extent to which chemical weathering influences river erosion. To explore the issue, the team travelled to the Big Island of Hawaii, where the bedrock is made entirely of volcanic basalt, to collect data on chemical weathering, rock strength, and erosion rates in streams across wet and dry regions of the island.

"Hawaii is a simple, natural laboratory for studying how climate controls river erosion because it has uniform lithology and a very extreme precipitation gradient," Murphy said. "We went to investigate if the local precipitation rate was changing the rock strength in the rivers and then looked for a mechanism to explain it."

They measured the strength of the rock using a Schmidt hammer, a device that measures surface hardness in the field, and also analyzed the chemistry and density of rock samples back in the lab to determine the influence of chemical weathering.

Consistent with their hypothesis, they found that bedrock was more chemically weathered and physically weaker where local precipitation rates were greater. More significant, Murphy said, was their finding that locations of high precipitation could maintain high erosion rates despite continuously exposing "fresh rock" -- rock that was previously below the eroded surface and is not chemically altered.

Fresh bedrock weathers rapidly when exposed at the surface, which weakens rock and allows it to be efficiently eroded by the river, the researchers found.

"This presents a positive feedback allowing river streambeds to maintain high weathering rates, weaker rock, and high erosion rates," Murphy said.

Based on their findings, the researchers modified a numerical model that describes how rivers cut into a landscape, Johnson said, finding that chemical weathering data drastically improved their ability to predict patterns of river incision.

"Once we included the climate effect demonstrating that the chemical weathering is weakening the bedrock and making it more erodible, we can do a much better job of matching the pattern and rates of incision that occur across this landscape." Johnson said.

Even though researchers examined only a single rock type, Murphy said that the mechanism linking chemical weathering to rock strength and erosion should apply to all types of rock. Understanding the relationship between erosion and chemical weathering can help tease out the role climate has on sculpting landscapes and influencing global cycles, Murphy said.

"The ability to better understand how landscapes erode is important, because bedrock erosion affects chemical weathering, which is a major component of the global carbon cycle and can influence global climate by the removal of carbon dioxide from the atmosphere," Murphy said. "The ability to model landscape evolution and how climate plays into it is important for tying these larger global cycles together."

The research was funded by the National Science Foundation and a Tulane Research Enhancement grant.

Story Source: The above post is reprinted from materials provided by University of Texas at Austin.

Journal Reference: Brendan P. Murphy, Joel P. L. Johnson, Nicole M. Gasparini, Leonard S. Sklar. Chemical weathering as a mechanism for the climatic control of bedrock river incision. *Nature*, 2016; 532 (7598): 223 DOI: 10.1038/nature17449.

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NCGS DINNER MEETING Wednesday May 25, 2016
Orinda Masonic Center, 9 Altarinda Road, Orinda, CA

Monterey Canyon: Superhighway to the Deep-Sea

Dr. Charlie Paull
Senior Scientist at the Monterey Bay Aquarium Research Institute (MBARI)

(Reservations are required by May 20, 2015, Limit 100 persons)
We are sorry but we will not be able to accommodate "walk-ins"

The **NCGS** is pleased to host this *special dinner meeting* with **Dr. Paull**. This annual event will be catered by *Back Forty Texas BBQ and consist of Pork Ribs and BBQ Chicken, Tossed Green Salad, BBQ Beans, and Fresh Corn Cobettes. A deluxe veggie burger is available upon request (see below). Desert will include assorted cookies and brownies. Wine will also be served.*

Dr. Charlie Paull will describe the on-going efforts to understand the geologic processes occurring within Monterey Submarine Canyon, offshore of central California. For perspective, Monterey Canyon is equivalent in size to the Grand Canyon. Submarine canyons in general are conduits in which sediment-laden flows (including the wide range of gravity flows from slumps to turbidity currents) swiftly transport massive amounts of sediment from the shallow ocean to the deep sea. While such flows are among the most important processes by which sediments are carried across the Earth's surface and are credited for forming the canyons, very few direct measurements have ever been made of what actually happens during the sediment flow events. The lack of empirical data on sediment flows is a consequence of the difficulty in accessing canyon floors, the inability to predict when flows will happen, and the reality that energetic flows put monitoring equipment at risk. To understand submarine canyons and to further deep-sea technology development, the Monterey Bay Aquarium Research Institute (MBARI) has taken on the challenge of monitoring sediment flows and making direct measurements within these events. To achieve this goal, state of the art robotic vehicles have been utilized and several novel new instruments have been developed. With these technologies, Charlie's group at MBARI and neighboring institutions, have demonstrated that sediment-laden flows occur on a sub-annual basis in Monterey Canyon and produced startling surprises as to what happens during these energetic submarine events. These efforts have changed the focus of marine geologic research on submarine flows from a forensic science to making real time measurements of the evolving system.

**********************************Dinner Logistics**
Social Hour: 6:00 – 6:45 pm; **Dinner**: 6:45 – 8:00 pm; **Presentation**: 8:00 – 9:00 pm
Cost: **$25/person**

******************* ✂ *************Registration **

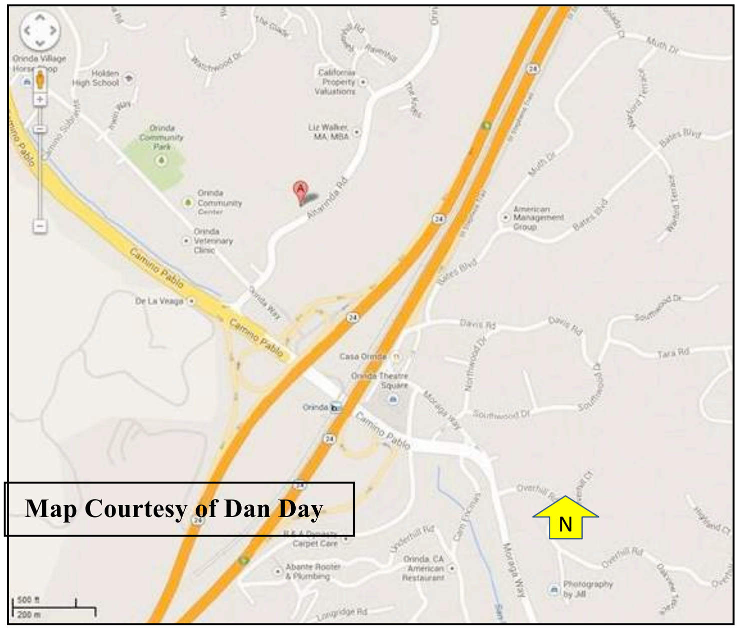
Name(s):____

E-mail:____

Phone (day):____________________Phone (cell)____________________

Check one per person: Regular Dinner: ____ Vegetarian: ___ # Attending__________Check Amount: ________

Please clip and mail this registration form with a check made out to **NCGS** to:
Barbara Matz, 803 Orion #2, Hercules CA 94547
Questions: e-mail barbara.matz@cbifederalservices.com; Phone: (415) 713-8482



Map Courtesy of Dan Day

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