

# NORTHERN CALIFORNIA GEOLOGICAL SOCIETY



Website: [www.ncgeolsoc.org](http://www.ncgeolsoc.org)

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## MEETING ANNOUNCEMENT

**DATE:** January 25, 2012

**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 of  
Integrative Biology at the University of  
California, Berkeley, Curator of  
Paleontology, University of California  
Museum of Paleontology and President  
of the National Center for Science  
Education.

## **What Darwin Said (and Didn't Say): Evolution, "Intelligent Design," and Education**

Rather than send an abstract, Dr. Padian sent a recent article he co-authored (a PDF copy is attached to this email but it is also available at the NCGS website). From the article's abstract we have extracted the following:

ID ('intelligent design') is not science, but a form of creationism; both are very different from the simple theological proposition that a divine Creator is responsible for the natural patterns and processes of the Universe. Its current version maintains that a 'Designer' must intervene miraculously to accomplish certain natural scientific events. The verdict in the 2005 case *Kitzmiller, et al. v. Dover School District, et al.* (in Harrisburg, PA, U.S.A.) was a landmark of American jurisprudence that prohibited the teaching of ID as science, identified it as religiously based, and forbade long-refuted 'criticisms of evolution' from introduction into public school classes. Much of the science of the trial was based on biochemistry; biochemists and other scientists have several important opportunities to improve scientific literacy and science education in American public schools ('state schools') by working with teachers, curriculum developers and textbook writers.

... Continued on back page...

# NCGS 2010 – 2011 Calendar

February 29, 2012

TBA

7:00 pm at Orinda Masonic Lodge

March 28, 2012

**Dr. Gerhard Neuhuber, GallZeidler Consultants, LLC; Caldecott Tunnel Construction 4<sup>th</sup> Bore / NATM Tunnel in San Francisco SH 24 California; After Three Tunnel Constructions and Investigation Programs – Are There No Surprises Anymore?**

7:00 pm at Orinda Masonic Lodge

April 25, 2012

**Dr. Ray Sullivan, Basin Floor to Shelf, The Lower Tertiary Sequences in the Sacramento Basin**

7:00 pm at Orinda Masonic Lodge

May 30, 2012

**(Dinner Meeting!)**

**Dr. Goeff Marcy, UC Berkeley; The Hunt for Another Earth**

6:00 pm at Orinda Masonic Lodge

June 27, 2012

TBA

7:00 pm at Orinda Masonic Lodge

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## Upcoming NCGS Events

Do you have a place you've wanted to visit for the geology? Let us know. We're definitely interested in ideas. For those suggestions, or for questions regarding, field trips, please contact Tridib Guha at: [Tridibguha@sbcglobal.net](mailto:Tridibguha@sbcglobal.net)

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## 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.

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## Bay Area Science

(<http://www.bayareascience.org/>)

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).

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## 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/>.

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## USGS Evening Public Lecture Series

The USGS Evening Public Lecture Series events are free and are intended for a general public audience that may not be familiar with the science being discussed. Monthly lectures are usually scheduled for the last Thursday evening of each month during most of the year but are occasionally presented on the preceding Thursday evening to accommodate the speakers. For more information on the lectures, including a map of the lecture location (Building 3, 2nd floor; Conference Room A) go to: <http://online.wr.usgs.gov/calendar/>

- January 26, 2012, *Lassen Volcanic National Park – a Wonderland of Volcanoes and Thermal Features*, Presented by Patrick Muffler, Geologist Emeritus

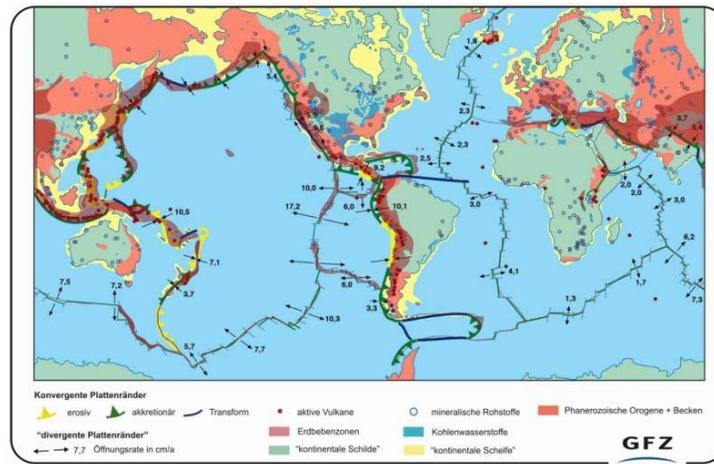
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## Flipped from Head to Toe: 100 Years of Continental Drift Theory

Exactly 100 years ago, on 6 January 1912, Alfred Wegener presented his theory of continental drift to the public for the first time. At a meeting of the Geological Association in Frankfurt's Senckenberg Museum, he revealed his thoughts on the supercontinent Pangaea, which broke apart and whose individual parts now drift across Earth as today's continents. In 1915, he published his book "The Origin of Continents and Oceans." Its third edition in 1922 was translated into the languages of the world and today is considered the foundation stone of plate tectonics.

Wegener's genius idea did not only find friends, because it had the main disadvantage that it lacked the engine to break apart the supercontinent and move huge continental masses over Earth's surface. Indeed, only by the seismology of the 1950s and through scientific drilling in the oceans in the 1960s, the foundation for plate tectonics was laid -- at the same time, however,

Wegener's groundbreaking theory was turned upside down.



The map (with German key) show the relationship between the borders of the lithosphere plates, the global earthquake hot spots as well as the development of reservoirs, which is concentrated along the active plate boundaries. Example: the largest copper reservoir in the world (Chuquibambata) is located in the Andes. (Credit: GFZ Potsdam)

### Seismological insights

Earthquakes are not only terrible natural disasters, they also offer a view inside Earth. It was the geophysicists Wadati and Benioff, who in 1954 independently discovered the systematic arrangement of earthquakes in the places which we now know as plate boundaries. "More than 90% of the global seismic energy is released at the plate boundaries," says Professor Michael Weber, head seismologist at the German Research Centre for Geosciences GFZ. "We use these earthquakes for tomographic screening of the Earth." With modern methods of scientific seismology it is even possible to reconstruct how quickly the continents moved. The speed record is held by India, which started to make its way from East Gondwana to Eurasia about 140 million years ago -- at a speed of 20 centimeters per year.

### Drilling into the ocean floor

The real breakthrough, however, came only when those findings were combined with the research results from the great ocean drilling programs of the sixties. Previously, using magnetic measurements of the ocean floor and topography of the seabed the mid-ocean ridges had been discovered, as well as a magnetic polarization of the rocks in parallel strips either side of mid-ocean ridges. Now, the obtained cores showed: No piece of the drilled ocean floor was older than 200 million years, and therefore decidedly younger than Wegener had assumed. Continental rocks, in contrast, can achieve an age of more than four billion years. Secondly, it could be shown that the ocean floor is very young in the immediate vicinity of the mid-ocean ridges. With increasing distance from these undersea mountains, the

rocks exhibit an increase in age. Thirdly, the ocean floors below the top layer of sediment are entirely of magmatic origin. "These results could in fact only allow one interpretation. From the interior of the Earth, hot, liquid rock rises to these ridges and pushes the ocean floor off to the side", explains Dr. Ulrich Harms, who at the GFZ directs the "Centre for Scientific Drilling." "Not the continents drift, but entire tectonic plates, which consist of continents, ocean floors, and parts of the upper mantle."

### Ascending rocks and the engine of plate tectonics

All these findings in the second half of the sixties put Wegener's ingenious discoveries into a correct context, and also flipped his theory from the head to its feet: not only were his assumptions as to the age of oceans and continents completely reversed, the idea that the continents plow the ocean turns around so that continents and oceans move together as a common upper part of the lithospheric plates. The continents float on top as the lightest rocks, so to speak.

These tectonic plates move, collide, grind past each other or drift apart. All these processes are associated with earthquakes, which can thus be explained as part of the overall process. But what forces the heavy rock inside Earth to rise? The enormous heat inside Earth's core and mantle comes in one part from the formation of Earth, in another from the radioactive decay of elements in the mantle. The heated rock rises and induces the movement expressed on the surface as a displacement of the plates.

### The quiet revolution in the theory of tectonics

The classical concept of tectonics as a quasi mechanical process of the movement and collision of rigid plates is now itself in disarray. "Recent findings show plate tectonics as a self-regulating system of interactions, in which all the subsystems of the planet earth are involved", explains Professor Onno Oncken. The Director of the Department "Geodynamics" at GFZ notes: "It is not a mechanical system, but rather complex feedback processes." The climate as example: high-altitude mountains have a decisive influence on the climate, of course. But that the climate in turn controls the tectonics, is a new discovery: the Andes, for example, are caused by the collision of the Nazca plate with South America. The humid climate of the South Andes leads to the erosion of material that ends up as sediment in the Pacific. The Nazca plate approaching from the west deposits this rock on the South American crust. The arid climate of the Northern and Central Andes, however, gives rise to no sediment, therefore the Nazca plate rasps off the continental crust here. The thus created great increase in friction in turn transmits a force that causes the Andean plateau to gain height and width. This in turn enhances the rain shadow on the west side of the Andes and additionally reduces erosion.

The classical notion of folded mountains as a result of a collision also had to be revised: "The Andes, for example, in their present form, exist for about 45 million years, the subduction of the Nazca plate beneath South America has been going on since the Paleozoic, so hundreds of millions of years longer," says Onno Oncken. Similarly, the interplay between the hot, rising rock masses and Earth's crust is much more complex than originally thought. When a hot rock bubble rises, the poorly heat-conductive lithosphere acts as a boundary layer to the surface like a blanket, which in turn increases the temperature further below. This heat buildup can eventually soften whole continents like a welding torch until they dissolve, as it happened around 140 to 130 million years ago, when Gondwana fell apart first in the East, then in the West.

At that time Africa also separated from South America, but it was exactly the contours of these two continents that sparked Wegener's idea. Professor Oncken: "Wegener's approach was the starting point, the plate tectonics of the previous century was the revolution in geoscientific perception. Today we see an equally thorough, quiet revolution in the theory of plate tectonics, because we understand our planet increasingly as a complete system."

**Story Source:** The above story is reprinted from materials provided by Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences, via [AlphaGalileo](http://AlphaGalileo).

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## Over 65 Million Years, North American Mammal Evolution Has Tracked With Climate Change

Climate changes profoundly influenced the rise and fall of six distinct, successive waves of mammal species diversity in North America over the last 65 million years, shows a novel statistical analysis led by Brown University evolutionary biologists. Warming and cooling periods, in two cases confounded by species migrations, marked the transition from one dominant grouping to the next.

History often seems to happen in waves -- fashion and musical tastes turn over every decade and empires give way to new ones over centuries. A similar pattern characterizes the last 65 million years of natural history in North America, where a novel quantitative analysis has identified six distinct, consecutive waves of mammal species diversity or "evolutionary faunas." What force of history determined the destiny of these groupings? The numbers say it was typically climate change.

"Although we've always known in a general way that mammals respond to climatic change over time, there

has been controversy as to whether this can be demonstrated in a quantitative fashion," said Christine Janis, professor of evolutionary biology at Brown University. "We show that the rise and fall of these faunas is indeed correlated with climatic change -- the rise or fall of global paleotemperatures -- and also influenced by other more local perturbations such as immigration events."



*Rhino-like animals. This painting by artist Carl Buell depicts a scene from the late Eocene of North America. The rhino-like animals in the background are brontotheres. The pony-sized Hyracodon, a closer relative of living rhinos, in the foreground. (Credit: Carl Buell)*

Specifically, of the six waves of species diversity that Janis and her Spanish collaborators recently describe online in *Proceedings of the National Academy of Sciences*, four show statistically significant correlations with major changes in temperature. The two transitions that show a weaker but still apparent correlation with the pattern correspond to periods when mammals from other continents happened to invade in large numbers, said Janis, who is the paper's senior and second author.

Previous studies of the potential connection between climate change and mammal species evolution have counted total species diversity in the fossil record over similar time periods. But in this analysis, led by postdoctoral scholar Borja Figueirido, the scientists asked whether there were any patterns within the species diversity that might be significant. They were guided by a similar methodology pioneered in a study of "evolutionary faunas" in marine invertebrates by Janis' late husband Jack Sepkoski, who was a paleontologist at the University of Chicago.

What the authors found is six distinct and consecutive groupings of mammal species that shared a common rise, peak, and decline in their numbers. For example, the "Paleocene fauna" had largely given way to the "early-middle Eocene fauna" by about 50 million years ago. Moreover, the authors found that these transfers of dominance correlated with temperature shifts, as reflected in data on past levels of atmospheric oxygen

(determined from the isotopes in the fossilized remains of deep sea microorganisms).

By the numbers, the research showed correlations between species diversity and temperature change, but qualitatively, it also provided a narrative of how the traits of typical species within each wave made sense given the changes in vegetation that followed changes in climate. For example, after a warming episode about 20 million years in the early Miocene epoch, the dominant vegetation transitioned from woodland to a savannah-like grassland. It is no surprise, therefore, that many of the herbivores that comprised the accompanying "Miocene fauna" had high-crowned teeth that allowed them to eat the foods from those savannah sources.

To the extent that the study helps clarify scientists' understanding of evolution amid climate changes, it does not do so to the extent that they can make specific predictions about the future, Janis said. But it seems all the clearer that climate change has repeatedly had meaningful effect over millions of years.

"Such perturbations, related to anthropogenic climatic change, are currently challenging the fauna of the world today, emphasizing the importance of the fossil record for our understanding of how past events affected the history of faunal diversification and extinction, and hence how future climactic changes may continue to influence life on earth," the authors wrote in the paper.

In addition to Janis and Figueirido at Brown, the other authors are Juan Perez-Claros and Paul Palmqvist at the University of Malaga and Miguel De Renzi at the University of Valencia in Spain. Figueirido is also affiliated with Malaga.

Grants from the Fulbright program, the Bushnell Foundation (to Brown) and the Spanish Ministry of Science and Innovation funded the research.

**Story Source:** The above story is reprinted from materials provided by Brown University.

**Journal Reference:** Borja Figueirido, Christine M. Janis, Juan A. Pérez-Claros, Miquel De Renzi, and Paul Palmqvist. **Cenozoic climate change influences mammalian evolutionary dynamics.** *PNAS*, December 27, 2011

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## Higher Wetland Methane Emissions Caused by Climate Warming 40,000 Years Ago

40,000 years ago rapid warming led to an increase in methane concentration. The culprit for this increase has now been identified. Mainly wetlands in high northern latitudes caused the methane increase, as discovered by a research team from the University of Bern and the German

Alfred Wegener Institute for Polar and Marine Research in the Helmholtz Association. This result refutes an alternative theory discussed amongst experts, the so-called "clathrate gun hypothesis." The latter assumed that large amounts of methane were released from the ocean sediment and led to higher atmospheric methane concentrations and thus to rapid climate warming.



*Wetland swamp. Higher wetland methane emissions were caused by climate warming 40,000 years ago. (Credit: iStockphoto)*

Earlier measurements on ice cores showed that the atmospheric methane concentration changed drastically in parallel to rapid climate changes occurring during the last ice age. Those climate changes – so-called Dansgaard-Oeschger events – were characterised by a sudden warming and an increase in methane concentration. However, it was not yet clear to what extent the climate changes 40,000 years ago led to the methane increase or vice versa. Climate researchers from the Universities in Bern and Copenhagen and from the Alfred Wegener Institute for Polar and Marine Research in Bremerhaven now conclude that the methane increase at that time was largely due to higher methane emissions from wetlands. As published by the researchers in the current issue of the journal *Science*, these natural methane sources produced more methane especially in high northern latitudes in response to the warming. Through their study the researchers also refute another controversial hypothesis, which claimed that large amounts of methane stored as clathrate in the ocean sediment along the continental margins was released and triggered the rapid warming.

The scientists stress, however, that the climate conditions 40,000 years ago are not comparable to the current climate evolution. "Our results do not imply that methane or other greenhouse gases play no role for climate change. Our study reflects natural climate conditions during the last ice age, long before mankind affected global climate by emitting greenhouse gases. At that time climate warming caused an increase in methane concentration, generating in turn a more substantial greenhouse effect. Nowadays, additional methane and carbon dioxide are artificially emitted into the atmosphere by human activities and are the main driver of the observed climate warming."

Ongoing studies of the Alfred Wegener Institute in Arctic permafrost regions take on greater importance in view of these research results.

### Novel analytical method: Clear isotopic "fingerprints"

In nature a few methane molecules (CH<sub>4</sub>) have one more neutron in the carbon and hydrogen atoms they are made of and are therefore a little heavier. Methane from wetland sources has fewer molecules with the heavier hydrogen atom than methane produced in the ocean. Accordingly, the marine and terrestrial methane sources have unique "isotopic fingerprints". Using these fingerprints, it is possible to quantify the emission of both sources. Developing a novel analytical method at the University of Bern and the Alfred Wegener Institute to take these "fingerprints" allowed the international team of scientists to come up with the unambiguous results now published in "Science".

**Story Source:** The above story is reprinted from materials provided by Helmholtz Association of German Research Centres, via EurekAlert!, a service of AAAS.

**Journal Reference:** Bock, M.; Schmitt, J.; Möller, L.; Spahni, R.; Blunier, T. & Fischer, H. **Hydrogen isotopes preclude marine hydrate CH<sub>4</sub> emissions at the onset of Dansgaard-Oeschger events.** *Science*, June 25, 2010

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## New Theory Emerges for Where Some Fish Became Four-Limbed Creatures

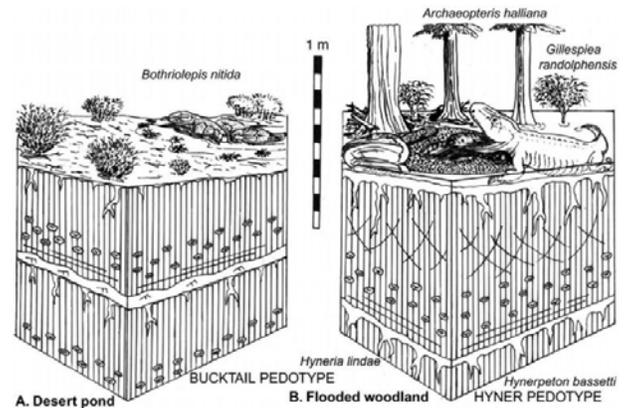
A small fish crawling on stumpy limbs from a shrinking desert pond is an icon of can-do spirit, emblematic of a leading theory for the evolutionary transition between fish and amphibians. This theorized image of such a drastic adaptation to changing environmental conditions, however, may, itself, be evolving into a new picture.

University of Oregon scientist Gregory J. Retallack, professor of geological sciences, says that his discoveries at numerous sites in Maryland, New York and Pennsylvania suggests that "such a plucky hypothetical ancestor of ours probably could not have survived the overwhelming odds of perishing in a trek to another shrinking pond."

This scenario comes from the late Devonian, about 390 million years ago to roughly 360 million years ago. Paleontologist Alfred Romer, who died in 1973 after serving on the faculties at the University of Chicago and Harvard University, saw this time as a period of struggle and escape -- and important in fish-tetrapod transition -- to ensure survival.

Reporting in the May 2011 issue of the *Journal of Geology*, Retallack, who also is co-director of paleontological collections at the UO's Museum of Natural and Cultural History, argues for a very different explanation. He examined numerous buried soils in rocks yielding footprints and bones of early transitional fossils between

fish and amphibians of Devonian and Carboniferous geological age. What he found raises a major challenge to Romer's theory.



*Romer's desert hypothesis, left, and Retallack's flooded woodland, right. (Credit: Image courtesy of University of Oregon)*

"These transitional fossils were not associated with drying ponds or deserts, but consistently were found with humid woodland soils," he said. "Remains of drying ponds and desert soils also are known and are littered with fossil fish, but none of our distant ancestors. Judging from where their fossils were found, transitional forms between fish and amphibians lived in wooded floodplains. Our distant ancestors were not so much foolhardy, as opportunistic, taking advantage of floodplains and lakes choked with roots and logs for the first time in geological history."

Limbs proved handy for negotiating woody obstacles, and flexible necks allowed for feeding in shallow water, Retallack said. By this new woodland hypothesis, the limbs and necks, which distinguish salamanders from fish, did not arise from reckless adventure in deserts, but rather were nurtured by a newly evolved habitat of humid, wooded floodplains.

The findings, he said, dampen both the desert hypothesis of Romer and a newer inter-tidal theory put forth by Grzegorz Niedbiedzki and colleagues at the University of Warsaw. In 2010, they published their discovery of eight-foot-long, 395-million-year-old tetrapods in ancient lagoonal mud in southeastern Poland, where Retallack also has been studying fossil soils with Polish colleague Marek Narkeiwicz.

"Ancient soils and sediments at sites for transitional fossils around the world are critical for understanding when and under what conditions fish first walked," Retallack said. "The Darwin fish of chrome adorning many car trunks represents a particular time and place in the long evolutionary history of life on earth." UO Academic Support Funds supported Retallack's research.

**Story Source:** The above story is reprinted from materials provided by University of Oregon.

**Journal Reference:** Gregory J. Retallack. **Woodland Hypothesis for Devonian Tetrapod Evolution.** *The Journal of Geology*, 2011; 119 (3): 235.

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## Chinese Fossils Shed Light On Evolutionary Origin of Animals from Single-Cell Ancestors

Evidence of the single-celled ancestors of animals, dating from the interval in Earth's history just before multicellular animals appeared, has been discovered in 570 million-year-old rocks from South China by researchers from the University of Bristol, the Swedish Museum of Natural History, the Paul Scherrer Institut and the Chinese Academy of Geological Sciences.



*570 million year old multicellular spore body undergoing vegetative nuclear and cell division (foreground) based on synchrotron x-ray tomographic microscopy of fossils recovered from rocks in South China. The background shows a cut surface through the rock - every grain (about 1 mm diameter) is an exceptionally preserved gooey ball of dividing cells turned to stone. (Credit: Image courtesy of University of Bristol)*

All life evolved from a single-celled universal common ancestor, and at various times in Earth history, single-celled organisms threw their lot in with each other to become larger and multicellular, resulting, for instance, in the riotous diversity of animals. However, fossil evidence of these major evolutionary transitions is extremely rare

The fossils, reported this week in *Science*, preserve stages in the life cycle of an amoeba-like organism dividing in asexual cycles, first to produce two cells, then four, eight, 16, 32 and so on, ultimately resulting in hundreds of thousands of spore-like cells that were then released to start the cycle over again. The pattern of cell division is so similar to the early stages of animal (including human) embryology that until now they were thought to represent the embryos of the earliest animals

The researchers studied the microscopic fossils using high energy X-rays at the Swiss Light Source in Switzerland,

revealing the organisation of the cells within their protective cyst walls. The organisms should not have been fossilized -- they were just gooey clusters of cells -- but they were buried in sediments rich in phosphate that impregnated the cell walls and turned them to stone.

Lead author Therese Hultgren said: "The fossils are so amazing that even their nuclei have been preserved."

Co-author Dr John Cunningham said: "We used a particle accelerator called a synchrotron as our X-ray source. It allowed us to make a perfect computer model of the fossil that we could cut up in any way that we wanted, but without damaging the fossil in any way. We would never have been able to study the fossils otherwise!"

This X-ray microscopy revealed that the fossils had features that multicellular embryos do not, and this led the researchers to the conclusion that the fossils were neither animals nor embryos but rather the reproductive spore bodies of single-celled ancestors of animals.

Professor Philip Donoghue said: "We were very surprised by our results -- we've been convinced for so long that these fossils represented the embryos of the earliest animals -- much of what has been written about the fossils for the last ten years is flat wrong. Our colleagues are not going to like the result."

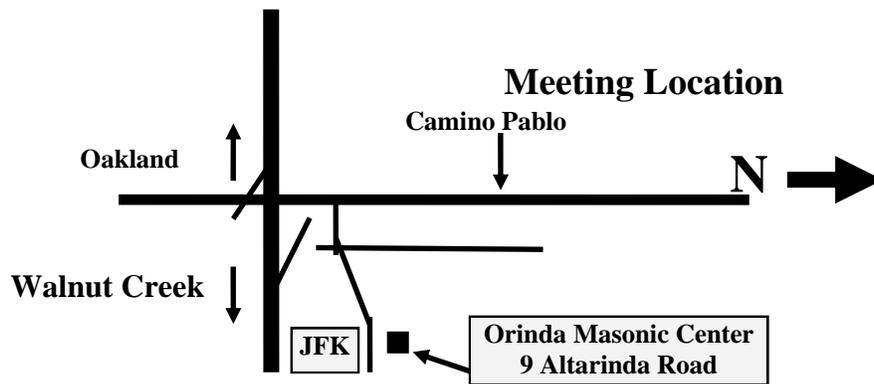
Professor Stefan Bengtson said: "These fossils force us to rethink our ideas of how animals learned to make large bodies out of cells."

The research was funded by the Natural Environment Research Council, the Swedish Research Council, the Paul Scherrer Institut, Ministry of Science and Technology of China, National Natural Science Foundation of China, and EU FP7.

Story Source: The above story is reprinted from materials provided by University of Bristol.

**Journal Reference:** Therese Hultgren, John A. Cunningham, Chongyu Yin, Marco Stampanoni, Federica Marone, Philip C. J. Donoghue, Stefan Bengtson. **Fossilized Nuclei and Germination Structures Identify Ediacaran "Animal Embryos" as Encysting Protists.** *Science*, 23 December 2011; Vol. 334 no. 6063 pp. 1696-1699

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**Biography:** Dr. Kevin Padian has been a professor of evolutionary biology and a curator in the Museum of Paleontology at the University of California, Berkeley for 32 years. He is interested in the origin of major evolutionary adaptations, such as flight, and in the history of thought about biology and evolution. A lot of his focus is on the “age of dinosaurs” and how dinosaurs evolved into birds. Much of his current research is on how dinosaurs grew and how they lived. He has authored, co-authored, or edited about 100 scientific articles, 100 popular articles, and seven books. He has twice been named Professeur Invité at the Collège de France, as well as at the Université de Paris and the Muséum National d’Histoire Naturelle. In America, he has been a Distinguished Lecturer of Sigma Xi and has won the Carl Sagan Award for the Popularization of Science. He was recently named a Fellow of the AAAS and named Western Evolutionary Biologist of the Year in 2008. Dr. Padian is also the long-time President of the National Center for Science Education, the pre-eminent organization that explains the creationism vs. science issue to the public in the US. In 2005 he was an expert witness in the Dover, Pennsylvania “Intelligent Design” trial, which ruled that ID is not science and cannot be presented as science in classrooms, and that bogus “criticisms” of evolution cannot be introduced to undermine its teaching.

**To Beat a Dead Horse - Have You Renewed?**

**Remember its - September 2011 to September 2012!**

**Please Use the Form in the September Newsletter or Visit the  
NCGS Website (as Always - Thanks!)**

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](mailto:rlngeology@sbcglobal.net) to sign up for this free service.*