NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

MEETING ANNOUNCEMENT

DATE: **June 27, 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. Donald L Gautier, US Geological Survey**

Volumes, Uncertainty and Costs of Undiscovered Arctic Petroleum

Undiscovered Arctic petroleum is one of the greatest remaining uncertainties of future energy supply. Most land areas north of the Arctic Circle have been at least partially explored, but the continental shelves are largely undrilled. Using a geology-based methodology, the U.S. Geological Survey has assessed the area north of the Arctic Circle. The Circum-Arctic Resource Appraisal (CARA) comprises three parts: (1) compilation of a geological map of sedimentary successions that are prospective for petroleum, (2) probabilistic assessment of undiscovered technically recoverable resources, and (3) appraisal of the costs to find, develop, and deliver the resources to market. Based on the new mapping, the Arctic was subdivided into 69 assessment units (AUs), 49 of which were quantitatively assessed. The CARA results suggest that approximately 30% of the world's undiscovered conventional gas and 13% of the world's undiscovered conventional oil might remain to be found in the Arctic, most of it offshore under less than 500m of water. The resources are unevenly distributed; billion BOE-plus oil or gas accumulations are predicted at a 50% probability in the South Kara Sea, the Barents Sea, East and West Greenland, the Mackenzie Delta, the Chukchi and Beaufort Seas, the Lena River Delta, and the Yenisey-Khatanga basin. Undiscovered natural gas is three times more abundant than oil and concentrated in Russian territory, where some of the world's largest conventional gas accumulations may still be found. The costs of finding, developing and delivering the yet-to-find resources are expected to be among the highest in the world. About half of the undiscovered Arctic oil can be delivered at 2008 costs of $300/barrel. Successful Arctic exploration will need to account for both geological and economic uncertainty.

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NCGS 2010 – 2011 Calendar

June 27, 2012
Dr. Donald L Gautier, US Geological Survey
Volumes, Uncertainty and Costs of Undiscovered Arctic Petroleum
7:00 pm at Orinda Masonic Lodge

Our Usual Summer Break

September 26, 2012 TBA

October 24, 2012 TBA

November 28, 2012 TBA

Upcoming NCGS Events

April 2012 (Date Remains Tentative)	***Caldecott Fourth Bore Project*** **CalTrans and Dr. Gerhard Neuhuber**
July 14, 2012	***Stroll to Subduction: Geology of Sunol Regional Wilderness*** **Dr. John Wakabayashi, Fresno State**

Do you have a place you've wanted to visit for the geology? Let us know. We're definitely interested in ideas. For those suggestions, or for questions regarding, field trips, please contact Tridib Guha at: **TridibGuha@yahoo.com.**

Peninsula Geologic Society

Upcoming meetings

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

Bay Area Science

(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).

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/.

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/

Thursday, June 28, 2012 Watch Live at 7pm PDT
USGS, Conference Room A, Bldg 3, Menlo Park

- **Scanning the Seafloor with Sound -- modern sonar reveals hidden hazards and resources; by David Finlayson, Marine Geologist**
  - The USGS seafloor mapping program supports scientific studies across most marine disciplines, including geologic mapping, mineral exploration and environmental characterization.
  - See dramatic, colorful imagery of underwater features presented using modern 3-D processing software
  - Learn how state-of-the-art sonar systems are being used by marine geologists and oceanographers to interpret and study the seafloor in unprecidented detail

Geoscience Teacher of Year Award

NCGS was pleased to have our Geoscience Teacher of the Year Award winner **Chung Sung Khong** and his wife attend the Annual Dinner meeting in May. He teaches at Yerba Buena High School in San Jose. His Earth & Environmental Science class with the Paleontology and Climate Units covers many aspects of

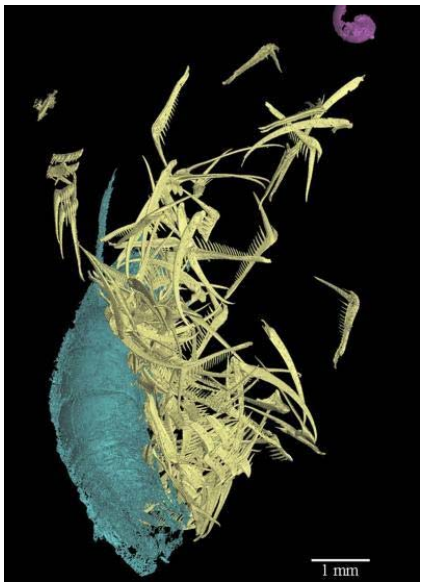
geoscience. The program also contains materials on observation and critical thinking. He includes a broad spectrum of materials and references as well as exercises that will help students apply basic principles and discuss specific topics in geological and environmental sciences.

Ammonites' Last Meal: New Light On Past Marine Food Chains

Scientists have discovered direct evidence of the diet of one of the most important group of ammonites, distant relatives of squids, octopuses and cuttlefishes. The discovery may bring a new insight on why they became extinct 65.5 million years ago, at the end of the Cretaceous.

Ammonites are among the world's most well known fossils but until now, there has been no experimental evidence of their place in the food chain. Using synchrotron X-rays, a Franco-American team of scientists led by Isabelle Kruta has discovered exceptionally preserved mouth organs of ammonites, along with the remains of a meal that show that these ammonites dined on plankton. Plankton was largely destroyed in the wake of the same asteroid impact that led to the demise of the dinosaurs and other species. After losing their source of food, ammonites and many other marine groups could not survive this cataclysmic event.

The findings are published in *Science*.



This is a 3-D reconstruction of the radula (tongue-like anatomical structure of mollusks for feeding) of a Baculites fossil. Teeth are depicted in yellow and the fragments of the fossil's last meal, caught between the jaws, in blue (for a crustacean) and pink (for a snail), respectively. (Credit: I. Kruta/MNHN)

Ammonites are extinct relatives of the squid and octopus. The Nautilus, a present-day marine invertebrate, is similar in appearance to many ammonites but is a more distant relative. Ammonites appeared about 400 million years ago (the Early Devonian) and experienced a population explosion in the early Jurassic. In fact, ammonites became such an abundant and diverse part of the marine fauna that they are used by paleontologists as classic "index" fossils to determine the relative ages of marine Mesozoic rocks in which they are found.

The team of researchers, led by Isabelle Kruta (MNHN, CNRS, UPMC), used the ESRF to perform X-ray scans of exceptional quality of Baculites fossils found on AMNH expeditions to the Great Plains in the United States. Results suggests that the large group of ammonites to which Baculites belongs, had jaws and radula (a kind of tongue covered with teeth) adapted for eating small prey floating in the water.

The study used synchrotron X-ray microtomography to check the presence, and then digitally reconstruct the mouths of three fossils found in South Dakota. The three-dimensional reconstructions are of such high quality that the jaws and teeth are revealed in their complete form. In addition, one specimen has a tiny snail and three tiny crustaceans in its mouth, one of them having been cut into two parts. Because these planktonic fossils are not found anywhere else on the specimen, the team thinks that the specimen died while eating its last meal rather than being scavenged by these organisms after death.

"I was astonished when I saw the teeth for the first time, and when I found the tiny plankton in the mouth," Isabelle Kruta (MNHN). "For the first time we were able to observe the delicacy of these exceptionally well preserved structures and use high quality details to obtain information on the ecology of these enigmatic animals."

"When you take into consideration the large lower jaws of ammonites in combination with this new information about their teeth, you realize that these animals must have been feeding in a different way from modern carrion-eating Nautilus," says Neil Landman (AMNH). "Ammonites have a surprisingly large lower jaw with slender teeth, but the effect is opposite to that of the wolf threatening to eat Little Red Riding Hood. Here, the bigger mouth facilitates feeding on smaller prey."

"X-ray synchrotron microtomography is currently the most sensitive technique for non-destructive investigations of internal structures of fossils. It started ten years ago with primate teeth, but is now widely applied in paleontology," says Paul Tafforeau (ESRF). " We made a first test on one of the Ammonite specimens after a test with a conventional scanner failed, and the results were so impressive that we scanned all the other

available samples, discovering nearly each time a radula and for one of them, many other structures."

Ammonite jaws lie just inside the body chamber. The research team's new scans of Baculites, a straight ammonite found world-wide, confirms older research that ammonites had multiple cusps on their radula teeth. The radula can now be seen in exquisite detail: the tallest cusp is 2 mm high, tooth shape varies from saber to comb-like, and teeth are very slender. The jaw is typical of this group of ammonites (the aptychophorans) in that the lower jaw is larger than the upper jaw and consists of two halves separated along a midline.

Until recently, the role of ammonites in the marine food web was unknown, although some clues were provided by Landman and colleagues on the shape of the jaw, as well as a 1992 paper by Russian scientists that reconstructed some of the internal structures by slicing fossils..

"The plankton in the Baculites jaws is the first direct evidence of how these uncoiled ammonites fed. This helps in understanding their evolutionary success in the Cretaceous." says Fabrizio Cecca (UPMC).

"Our research suggests several things. First, the radiation of aptychophoran ammonites might be associated with the radiation of plankton during the Early Jurassic," say Landman. "In addition, plankton were severely hit at the Cretaceous-Tertiary boundary, and the loss of their food source probably contributed to the extinction of ammonites. This research has implications for understanding carbon cycling during this time."

Isabelle Rouget (UPMC) agrees, adding that "we now realize that ammonites occupied a different niche in the food chain than we previously thought."

This research was supported by the Centre National de la Recherche Scientifique (CNRS, France), the Museum National d´Histoire Naturelle (MNHN, Paris, France) , the Université Pierre et Marie Curie (UPMC, Paris, France), the American Museum of Natural History (AMNH, New York, USA) and the European Synchrotron Radiation Facility (ESRF, Grenoble, France).

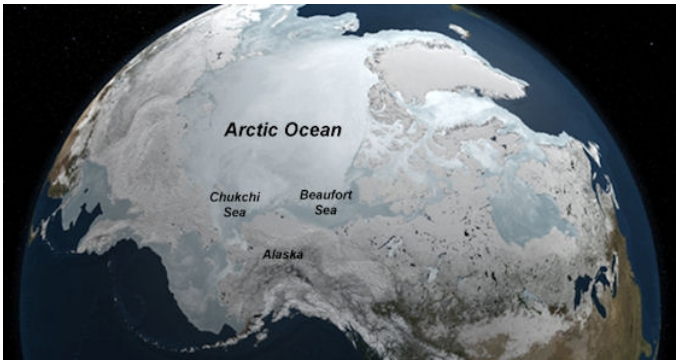
Story Source: The above story is reprinted from materials provided by European Synchrotron Radiation Facility.

Journal References: Isabelle Kruta, Neil Landman, Isabelle Rouget, Fabrizio Cecca, Paul Tafforeau. **The Role of Ammonites in the Mesozoic Marine Food Web Revealed by Jaw Preservation**. *Science*, 2011; 331 (6013): 70-72 DOI: 10.1126/science.1198793 and Kazushige Tanabe. **The Feeding Habits of Ammonites**. *Science*, 2011; 331 (6013): 37-38 DOI: 10.1126/science.1201002

Unprecedented Blooms of Ocean Plant Life

June 8, 2012: Scientists have made a biological discovery in Arctic Ocean waters as unexpected as finding a rainforest in the middle of a desert. A NASA-sponsored expedition named ICESCAPE punched through three-feet of sea ice to find waters richer in microscopic marine plants, essential to all sea life, than any other ocean region on Earth.

"If someone had asked me before the expedition whether we would see under-ice blooms, I would have told them it was impossible," said Kevin Arrigo of Stanford University in Stanford, Calif., leader of the ICESCAPE mission and lead author of the new study. "This discovery was a complete surprise."



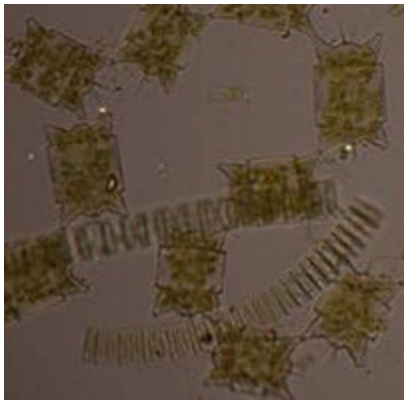
In the summers of 2010 and 2011, the Impacts of Climate change on the Eco-Systems and Chemistry of the Arctic Pacific Environment (ICESCAPE) shipborne expedition explored the biology, ecology and biogeochemistry of Arctic waters in the Beaufort and Chukchi seas. (Credit: NASA)

The microscopic plants, called phytoplankton, are the base of the marine food chain. Phytoplankton were thought to grow in the Arctic Ocean only after sea ice had retreated for the summer. Scientists now think that the thinning Arctic ice is allowing sunlight to reach the waters under the sea ice, catalyzing the plant blooms where they had never been observed.

The finding reveals a new consequence of the Arctic's warming climate and provides an important clue to understanding the impacts of a changing climate and environment on the Arctic Ocean and its ecology.

The discovery was made during ICESCAPE expeditions in the summers of 2010 and 2011. Scientists onboard a U.S. Coast Guard icebreaker explored Arctic waters in the Beaufort and Chukchi seas along Alaska's western and northern coasts. During the July 2011 Chukchi Sea leg of ICESCAPE, the researchers observed blooms beneath the ice that extended from the sea-ice edge to 72 miles into the ice pack. Ocean current data revealed that these blooms developed under the ice and had not drifted

there from open water, where phytoplankton concentrations can be high.



An assemblage of diatoms, one of the most common kinds of phytoplankton, as seen through a microscope. These tiny oceanic plants were in a sample of water collected about 5 feet below the ice during the 2011 ICESCAPE campaign. (Credit: William M. Balch/Bigelow Laboratory for Ocean Sciences).

The phytoplankton were extremely active, doubling in number more than once a day. Blooms in open waters grow at a much slower rate, doubling in two to three days. These growth rates are among the highest ever measured for polar waters. Researchers estimate that phytoplankton production under the ice in parts of the Arctic could be up to 10 times higher than in the nearby open ocean.

"Part of NASA's mission is pioneering scientific discovery, and this is like finding the Amazon rainforest in the middle of the Mojave Desert," said Paula Bontempi, NASA's ocean biology and biogeochemistry program manager in Washington. "We embarked on ICESCAPE to validate our satellite ocean-observing data in an area of the Earth that is very difficult to get to. We wound up making a discovery that hopefully will help researchers and resource managers better understand the Arctic."

The discovery has implications for the broader Arctic ecosystem, including migratory species such as whales and birds. Phytoplankton are eaten by small ocean animals, which are eaten by larger fish and ocean animals. A change in the timeline of the blooms can cause disruptions for larger animals that feed either on phytoplankton or on the creatures that eat these microorganisms. "It could make it harder and harder for migratory species to time their life cycles to be in the Arctic when the bloom is at its peak," Arrigo noted. "If their food supply is coming earlier, they might be missing the boat."

Previously, researchers thought the Arctic Ocean sea ice blocked most sunlight needed for phytoplankton growth. But in recent decades younger and thinner ice has replaced much of the Arctic's older and thicker ice. This young ice is almost flat and the ponds that form when snow cover melts in the summer spread much wider than those on rugged older ice.

The shallow but extensive ponds that form on sea ice when its snow cover melts in the summer act as windows, letting light penetrate the ice cap. (Credit: Don Perovich/U.S. Army Cold Regions and Engineering Laboratory).

These extensive but shallow melt ponds act as windows to the ocean, letting large amounts of sunlight pass through the ice to reach the water below, said Donald Perovich, a geophysicist with the U.S. Army Cold Regions and Engineering Laboratory in Hanover, N.H., who studied the optical properties of the ice during the ICESCAPE expedition.

"When we looked under the ice, it was like a photographic negative. Beneath the bare-ice areas that reflect a lot of sunlight, it was dark. Under the melt ponds, it was very bright," Perovich said. He is currently visiting professor at Dartmouth College's Thayer School of Engineering.

"At this point we don't know whether these rich phytoplankton blooms have been happening in the Arctic for a long time and we just haven't observed them before," added Arrigo. "These blooms could become more widespread in the future, however, if the Arctic sea ice cover continues to thin."
The findings were published in the journal *Science*.

Were Dinosaurs Undergoing Long-Term Decline Before Mass Extinction?

Despite years of intensive research about the extinction of non-avian dinosaurs about 65.5 million years ago, a fundamental question remains: were dinosaurs already undergoing a long-term decline before an asteroid hit at the end of the Cretaceous? A study led by scientists at the American Museum of Natural History gives a multifaceted answer.

The findings, published online May 1 in *Nature Communications*, suggest that in general, large-bodied, "bulk-feeding" herbivores *were* declining during the last 12 million years of the Cretaceous. But carnivorous dinosaurs and mid-sized herbivores were not. In some cases, geographic location might have been a factor in the animals' biological success.

Like other meat-eaters analyzed in the new research, Troodon formosus, a coelurosaur, maintained a stable level of biodiversity leading up to the mass extinction at the end of the Cretaceous. (Credit: AMNH/J. Brougham)

"Few issues in the history of paleontology have fueled as much research and popular fascination as the extinction of non-avian dinosaurs," said lead author Steve Brusatte, a Columbia University graduate student affiliated with the Museum's Division of Paleontology. "Did sudden volcanic eruptions or an asteroid impact strike down dinosaurs during their prime? We found that it was probably much more complex than that, and maybe not the sudden catastrophe that is often portrayed."

The research team, which includes Brusatte; Mark Norell, chair of the Museum's Division of Paleontology; and scientists Richard Butler of Ludwig Maximilian University of Munich and Albert Prieto-M‡rquez from the Bavarian State Collection for Palaeontology, both in Germany, is the first to look at dinosaur extinction based on "morphological disparity"-the variability of body structure within particular groups of dinosaurs. Previous research was based almost exclusively on estimates of changes in the number of dinosaur species over time. However, it can be very difficult to do this accurately.

"By looking just at trends in taxonomic diversity, you get conflicting answers about the state of dinosaurs prior to extinction," Brusatte said. "This is because the results can be biased by uneven sampling of the fossil record. In places where more rock and fossils were formed, like in America's Great Plains, you'll find more species. We wanted to go beyond a simple species count for this study."

By looking at the change in biodiversity within a given dinosaur group over time, researchers can create a rough snapshot of the animals' overall well-being. This is because groups that show an increase in variability might have been evolving into more species, giving them an ecological edge. On the other hand, decreasing variability might be a warning sign of extinction in the long term.

The researchers calculated morphological disparity for seven major dinosaur groups using databases that include wide-ranging characteristics about the intricate skeletal structure of nearly 150 different species.

"People often think of dinosaurs as being monolithic-we say 'The dinosaurs did this, and the dinosaurs did that,'" Butler said. "But dinosaurs were hugely diverse. There were hundreds of species living in the Late Cretaceous, and these differed enormously in diet, shape, and size. Different groups were probably evolving in different ways and the results of our study show that very clearly."

The researchers found that hadrosaurs and ceratopsids, two groups of large-bodied, bulk-feeding herbivores-animals that did not feed selectively-may have experienced a decline in biodiversity in the 12 million years before the dinosaurs ultimately went extinct. In contrast, small herbivores (ankylosaurs and pachycephalosaurs), carnivorous dinosaurs (tyrannosaurs and coelurosaurs), and enormous herbivores without advanced chewing abilities (sauropods) remained relatively stable or even slightly increased in biodiversity.

As a complication, hadrosaurs showed different levels of disparity in different locations. While declining in North America, the disparity of this dinosaur group seems to have been increasing in Asia during the latest Cretaceous.

"These disparity calculations paint a more nuanced picture of the final 12 million years of dinosaur history," Brusatte said. "Contrary to how things are often perceived, the Late Cretaceous wasn't a static 'lost world' that was violently interrupted by an asteroid impact. Some dinosaurs were undergoing dramatic changes during this time, and the large herbivores seem to have been mired in a long-term decline, at least in North America."

In North America, extreme fluctuations of the inland Western Interior Sea and mountain building might have affected the evolution of dinosaurs in distinct ways from species on other continents. Therefore, the authors say, the North American record might not be representative of a global pattern, if one exists. They also note that there is no way to tell whether a declining dinosaur group would have survived if the asteroid had not struck Earth.

"Even if the disparity of some dinosaur clades or regional faunas were in decline, this does not automatically mean that dinosaurs were doomed to extinction," Norell said. "Dinosaur diversity fluctuated throughout the Mesozoic, and small increases or decreases between two or three time intervals may not be noteworthy within the context of the entire 150-million-year history of the group."

Funding for this study was provided by the National Science Foundation through the Division of Earth Sciences, the Division of Biological Infrastructure, a Graduate Research Fellowship, and a Doctoral Dissertation Improvement Grant; the German Research Foundation's Emmy Noether Programme; the Alexander von Humboldt Foundation; the Charlotte and Walter Kohler Charitable Trust; the American Museum of Natural History; and Columbia University.

Story Source:

The above story is reprinted from materials provided by American Museum of Natural History.

Journal Reference: Stephen L. Brusatte, Richard J. Butler, Albert Prieto-Márquez, Mark A. Norell. **Dinosaur morphological diversity and the end-Cretaceous extinction**. *Nature Communications*, 2012; 3: 804 DOI: 10.1038/ncomms1815

What wiped out woolly mammoths? Lots of culprits

Climate change, human hunters and shifting habitats all played part, researchers say

By Charles Q. Choi

Woolly mammoths were apparently driven to extinction by a multitude of culprits, with climate change, human hunters and shifting habitats all playing a part in the long decline of these giants, researchers say.

Woolly mammoths wandered the planet for about 250,000 years and vanished from Siberia by about 10,000 years ago. Mauricio Anton

Woolly mammoths (Mammuthus primigenius) wandered the planet for about 250,000 years, ranging from Europe to Asia to North America covered in hair up to 20 inches (50 centimeters) long and possessing curved tusks up to 16 feet (4.9 meters) long. Nearly all of these giants vanished from Siberia by about 10,000 years ago, although dwarf mammoths survived on Wrangel Island in the Arctic Ocean until 3,700 years ago.

Scientists have often speculated over what might have driven the mammoths to extinction. For instance, for years researchers suspected that ancient human tribes hunted the mammoths and other ice age giants to oblivion. Others have suggested that a meteor strike might have drastically altered the climate in North America about 12,900 years ago, wiping out most of the large mammals there, the so-called " Younger Dryas impact hypothesis."

Now an analysis of thousands of fossils, artifacts and environmental sites spanning millennia suggest that no one killer is to blame for the demise of the woolly mammoths.

"These findings pretty much dispel the idea of any one factor, any one event, as dooming the mammoths," researcher Glen MacDonald, a geographer at the University of California, Los Angeles, told LiveScience.

Mammoth database

Scientists investigated the extinction of woolly mammoths living in Beringia, the last refuge of mammoths that nowadays lies mostly submerged under the icy waters of the Bering Strait. To get an idea of woolly mammoth abundance, past climate and other environmental factors, they analyzed samples from more than 1,300 woolly mammoths, nearly 450 pieces of wood, nearly 600 archaeological sites and more than 650 peatlands, compiling their ages and locations to see how these giants and their environments changed over time. They also probed mammoth genetic data found in fossils of the titans.

"There will be people talking about the incompleteness of the fossil record, and there'll always be uncertainties here, no question, but the size of our database is thousands of data points, so I think we can see the general patterns," MacDonald said.

Their results revealed woolly mammoths flourished in the open steppe of Beringia between 30,000 to 45,000 years ago, with its relatively abundant grass and willow trees. The area wasn't as warm then as today, but not as cold as the height of the ice age. "That seemed to be very favorable for mammoths, in terms of abundance," MacDonald said. Humans coexisted with mammoths back then, clearly not driving them to extinction at that time.

Later, during the iciest part of the ice age 20,000 to 25,000 years ago, the "Last Glacial Maximum," northern woolly mammoth populations declined, likely because the area became too barren to be hospitable. However, during that time, the giants became abundant in the warmer interior parts of Siberia.

"There was an old idea that cold glacial conditions like the Last Glacial Maximum were optimal for mammoths," MacDonald said. "That idea now doesn't really hold water."

Northern refuge

Northern mammoth populations grew after the Last Glacial Maximum, but then dipped again during the Younger Dryas period about 12,900 years ago. Although there is controversy as to what happened at that time, "there was certainly a very rapid and profound cooling of many regions then, followed by rapid warming," MacDonald said. "Did this cause the extinction of the mammoth? Absolutely not. They were still present in far northern sites at the end of the Younger Dryas. Right now it's not quite definitive how great an impact the Younger Dryas had."

The last mammoths seen on the continents were concentrated in the north. They apparently disappeared about 10,000 years ago as the climate warmed and peatlands, wet tundra and coniferous forests developed, environments to which mammoths were poorly suited. The long-lasting proximity between mammoths and humans suggested that our species was perhaps a factor in the beasts' decline, possibly killing off the final island populations of woolly mammoths that went extinct 3,700 years ago.

Overall, these findings suggest the mammoths experienced a long decline due to many factors.

"There was no one event that ended the mammoths," MacDonald said. "It was really the coalescence of climate change and the habitat change that triggered (it), and also human predators on the landscape at the end."

These findings regarding mammoths could shed light on what species today might face in the future. "Mammoths faced profound climate change and very profound changes in their habitat and landscape, and also faced pressure from humans," MacDonald said. "Now think about the 21st century, where we're seeing rapid climate change, massive changes in the landscape and certainly pressure from humans on the environment. Species today are facing the same sorts of challenges the mammoths did, but the rate of those changes today are much greater than what mammoths faced."

Future research can focus on other animals once plentiful across Beringia, such as horse and bison. The scientists detailed their findings online June 12 in the journal Nature Communications.

It Took Earth Ten Million Years to Recover from Greatest Mass Extinction

It took some 10 million years for Earth to recover from the greatest mass extinction of all time, latest research has revealed.

New research reveals that it took some 10 million years for Earth to recover from the greatest mass extinction of all time, some 250 million years ago. (Credit: © byheaven / Fotolia)

Life was nearly wiped out 250 million years ago, with only 10 per cent of plants and animals surviving. It is currently much debated how life recovered from this cataclysm, whether quickly or slowly.

Recent evidence for a rapid bounce-back is evaluated in a new review article by Dr Zhong-Qiang Chen, from the China University of Geosciences in Wuhan, and Professor Michael Benton from the University of Bristol. They find that recovery from the crisis lasted some 10 million years, as explained May 27 in *Nature Geoscience.*

There were apparently two reasons for the delay, the sheer intensity of the crisis, and continuing grim conditions on Earth after the first wave of extinction.

The end-Permian crisis, by far the most dramatic biological crisis to affect life on Earth, was triggered by a number of physical environmental shocks -- global warming, acid rain, ocean acidification and ocean anoxia. These were enough to kill off 90 per cent of living things on land and in the sea.

Dr Chen said: "It is hard to imagine how so much of life could have been killed, but there is no doubt from some of the fantastic rock sections in China and elsewhere round the world that this was the biggest crisis ever faced by life."

Current research shows that the grim conditions continued in bursts for some five to six million years after the initial crisis, with repeated carbon and oxygen crises, warming and other ill effects.

Some groups of animals on the sea and land did recover quickly and began to rebuild their ecosystems, but they suffered further setbacks. Life had not really recovered in these early phases because permanent ecosystems were not established.

Professor Benton, Professor of Vertebrate Palaeontology at the University of Bristol, said: "Life seemed to be getting back to normal when another crisis hit and set it back again. The carbon crises were repeated many times, and then finally conditions became normal again after five million years or so."

Finally, after the environmental crises ceased to be so severe, more complex ecosystems emerged. In the sea, new groups, such as ancestral crabs and lobsters, as well as the first marine reptiles, came on the scene, and they formed the basis of future modern-style ecosystems.

Professor Benton added: "We often see mass extinctions as entirely negative but in this most devastating case, life did recover, after many millions of years, and new groups emerged. The event had re-set evolution. However, the causes of the killing -- global warming, acid rain, ocean acidification -- sound eerily familiar to us today. Perhaps we can learn something from these ancient events."

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

Journal Reference: Zhong-Qiang Chen, Michael J. Benton. **The timing and pattern of biotic recovery following the end-Permian mass extinction**. *Nature Geoscience*, 2012; DOI: 10.1038/ngeo1475

Bird Color Variations Speed Up Evolution

Researchers have found that bird species with multiple plumage colour forms within in the same population, evolve into new species faster than those with only one colour form, confirming a 60-year-old evolution theory.

Left: Grey morph of the Eastern Screech Owl (Megascops asio). Right: Rufous morph of the Eastern Screech Owl. (Credit: Left: Wolfgang Wander via Wikipedia, Creative Commons license; Right: Greg Hume via Wikipedia, Creative Commons license)

The global study used information from birdwatchers and geneticists accumulated over decades and was conducted by University of Melbourne scientists Dr Devi Stuart-Fox and Dr Andrew Hugall (now based at the Melbourne Museum) and is published in the journal *Nature*.

The link between having more than one colour variation (colour polymorphism) like the iconic red, black or yellow headed Gouldian finches, and the faster evolution of new species was predicted in the 1950s by famous scientists such as Julian Huxley, but this is the first study to confirm the theory.

By confirming a major theory in evolutionary biology, we are able to understand a lot more about the processes that create biodiversity said Dr Devi Stuart-Fox from the University's Zoology Department.

"We found that in three families of birds of prey, the hawks and eagles, the owls and the nightjars, the presence of multiple colour forms leads to rapid generation of new species," Dr Stuart-Fox said.

"Well known examples of colour polymorphic species in these families include the Australian grey goshawk which has a grey and pure white form, the North American eastern screech owl and the Antillean nighthawk, each with grey and red forms."

The team focused on birds because although colour polymorphism occurs in many animals (such as fish, lizards, butterflies and snails), there is a wealth of information on colour variation in birds, as well as on species classification (taxonomy), partly thanks to birdwatchers or 'twitchers'.

"We looked at five bird families with a high proportion of colour polymorphism and compared their rates of evolution with those with only one colour form," Dr Stuart-Fox said.

By modeling evolutionary rates using publicly available genetic information accumulated over a quarter of a century, the study found that colour polymorphism speeds up the generation of new species. Colour polymorphic species tend to evolve into species with only one colour form (monomorphic), explaining why existing species with different colour forms are relatively young and also rare.

The study found that colour polymorphic species were younger not only in the birds of prey but in the songbirds, which account for more than half of the world's bird species.

Study co-author Dr Andrew Hugall noted that when scientists like Julian Huxley proposed that colour polymorphism speeds up the generation of new species over half a century ago, they did not have the huge amounts of data needed to support it.

"Using many decades of natural history information and 25 years of genetic sequence information we were able to generate the massive family trees, such as a tree of more than four thousand songbirds, needed to model rates of bird evolution in this study," he said.

"Now that we've identified this pattern for the first time, our next step is to test some of the explanations proposed for why colour polymorphism leads to accelerated evolution."

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

Journal Reference: Andrew F. Hugall, Devi Stuart-Fox. **Accelerated speciation in colour-polymorphic birds**. *Nature*, 2012; DOI: 10.1038/nature11050

Date and Rate of Earth's Most Extreme Extinction Pinpointed: Results Stem from Largest Ever Examination of Fossil Marine Species

It's well known that Earth's most severe mass extinction occurred about 250 million years ago. What's not well known is the specific time when the extinctions occurred. A team of researchers from North America and China have published a paper in *Science* which explicitly provides the date and rate of extinction.

Charles Henderson (middle) of the University of Calgary collects material from a sedimentary layer in Shangsi, Sichuan Province, China. This was one of more important sections studied for ash layers and marine fossils used to pinpoint the dates and rate of Earth's massive extinction. (Credit: Charles Henderson)

"This is the first paper to provide rates of such massive extinction," says Dr. Charles Henderson, professor in the Department of Geoscience at the University of Calgary and co-author of the paper: Calibrating the end-Permian mass extinction. "Our information narrows down the possibilities of what triggered the massive extinction and any potential kill mechanism must coincide with this time."

About 95 percent of marine life and 70 percent of terrestrial life became extinct during what is known as the end-Permian, a time when continents were all one land mass called Pangea. The environment ranged from desert to lush forest. Four-limbed vertebrates were becoming diverse and among them were primitive amphibians, reptiles and a group that would, one day, include mammals.

Through the analysis of various types of dating techniques on well-preserved sedimentary sections from South China to Tibet, researchers determined that the mass extinction peaked about 252.28 million years ago and lasted less than 200,000 years, with most of the extinction lasting about 20,000 years.

"These dates are important as it will allow us to understand the physical and biological changes that took place," says Henderson. "We do not discuss modern climate change, but obviously global warming is a biodiversity concern today. The geologic record tells us that 'change' happens all the time, and from this great extinction life did recover." There is ongoing debate over whether the death of both marine and terrestrial life coincided, as well as over kill mechanisms, which may include rapid global warming, hypercapnia (a condition where there is too much CO_2 in the blood stream), continental aridity and massive wildfires. The conclusion of this study says extinctions of most marine and terrestrial life took place at the same time. And the trigger, as suggested by these researchers and others, was the massive release of CO_2 from volcanic flows known as the Siberian traps, now found in northern Russia.

Henderson's conodont research was integrated with other data to establish the study's findings. Conodonts are extinct, soft-bodied eel-like creatures with numerous tiny teeth that provide critical information on hydrocarbon deposits to global extinctions.

Story Source: The above story is reprinted from materials provided by University of Calgary. The original article was written by Leanne Yohemas.

Journal Reference: Shu-Zhong Shen, James L. Crowley, Yue Wang, Samuel A. Bowring, Douglas H. Erwin, Peter M. Sadler, Chang-Qun Cao, Daniel H. Rothman, Charles M. Henderson, Jahandar Ramezani, Hua Zhang, Yanan Shen, Xiang-Dong Wang, Wei Wang, Lin Mu, Wen-Zhong Li, Yue-Gang Tang, Xiao-Lei Liu, Lu-Jun Liu, Yong Zeng, Yao-Fa Jiang, Yu-Gan Jin. **Calibrating the End-Permian Mass Extinction**. *Science*, 2011; DOI: 10.1126/science.1213454

NORTHERN CALIFORNIA GEOLOGICAL SOCIETY

NCGS FIELD TRIP
Saturday July 14, 2012

STROLL TO SUBDUCTION: GEOLOGY OF SUNOL REGIONAL WIIDERNESS, CALIFORNIA

John Wakabayashi, Professor, California State University, Fresno

The title of this field trip honors the late Clyde Wahrhaftig, who wrote the marvelous field trip guide "Streetcar to Subduction"; here we will hike instead of take the bus, though. At Sunol Regional Wilderness we will view some fabulous exposures of the rock record of subduction preserved in the notorious Franciscan subduction complex as well as features that testify to the dynamic history of landscape evolution that followed the termination of subduction. These features are part of a rapidly changing understanding of the subduction process and the field relationships we see also have important practical ramifications in engineering geology. The geology we will see consists of Franciscan Complex rocks overlain by Miocene marine sedimentary rocks deposited during the early parts of the transform regime that followed the termination of Franciscan subduction. Multiple generations of landslides and strath terraces cover the bedrock in many places and the distinction between in-place Franciscan bedrock and landslide material poses challenges even to the experienced field geologist. The combination of strath terraces and landslides records a complex history of rock uplift and landscape response. All of the Franciscan bedrock has been subducted to depths sufficient to grow blueschist facies or higher grade metamorphic mineral assemblages. These Franciscan rocks record burial depths of ca. 30 km or more. Block-in-matrix units, or mélange, comprise most of the Franciscan exposures, and Sunol allows us exceptional views of the matrix in multiple localities. The matrix shows a gradation between unstrained sedimentary breccia (submarine debris flow deposits) to foliated matrix material that many have called typical "tectonic" mélange matrix. Matrix types include shale (probably most common), serpentinite, sandstone, and locally, mafic volcanic rocks. The gradation between undeformed sedimentary deposits and deformed matrix demonstrates that exotic blocks were introduced into the mélange by sedimentary processes rather than by extreme tectonic strain. Moreover, the blocks also show evidence of at least one earlier stage of high-pressure metamorphism that predates their sedimentation into the mélange. Some blocks may record two stages of pre-mélange high-pressure metamorphism. Given that the matrix itself has been metamorphosed at blueschist facies depths, all blocks record at least two partial subduction to surface exposure cycles. The recognition of the gradation between undeformed breccia and deformed matrix, as well as the recognition of sandstone as a common matrix type also has important implications for engineering characterization of mélanges, given that a block-in-matrix unit can grade from having little block-matrix strength contrast to having the significant block-matrix strength contrast that one expects for an "engineering mélange". This point is driven home by one locality where we find that breccia (i.e. "matrix") rather than a block, makes up one of the largest pinnacles of bedrock in the entire park! Yes, geology becomes ever more complicated for us. But without challenge, where would the fun be?

This field trip will be hiking field trip, and the hike will be moderate – something like 6-7 mi 2000' (gross, not net) of elevation or so. Participants will need to bring a lot of water and fairly rugged footwear, given that we will be doing some off trail hiking. We need to minimize the number of vehicles. Carpool is a must, we will circulate attendees list.

THIS FIELD TRIP WILL BE LIMITED TO 50 PEOPLE.

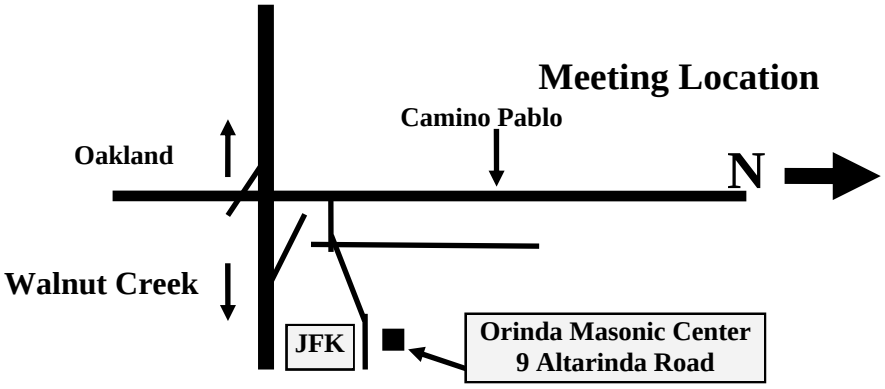
********** **Field Trip Logistics** **********

Time & Departure: July 14, 2012, 8:00 am, Sunol Regional Wilderness, parking lot

Cost: $40/person (guidebook, lunch, refreshments, soft drinks)

**********REGISTRATION FORM (Sunol Field Trip) **********

Name:_____ E-mail:_____
City Residence:_____ Phone: ____ _____ Phone (alternate):_____
Lunch: 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) 370-0685 (evening) (925) 451-1999 (day)



Speaker Biography: Dr. Donald L. Gautier is a geologist with the Energy Resources Program of the United States Geological Survey. Born in Los Angeles, he holds a Ph.D. in geology from the University of Colorado and worked for Mobil Oil Corporation before joining the USGS in 1977. He is the author of more than 200 publications, many of which concern evaluation of undiscovered oil and gas resources. Gautier leads the USGS World Energy Project and was the principal investigator for the recently-completed USGS Circum-Arctic Resource Appraisal. His residence is in Palo Alto, California.

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

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