

# NORTHERN CALIFORNIA GEOLOGICAL SOCIETY



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

**President:**

Barb Matz,  
[barbara.matz@shawgrp.com](mailto:barbara.matz@shawgrp.com)  
Shaw Group, Inc.

**President-Elect:**

Mark Sorensen  
[msorensen@itsi.com](mailto:msorensen@itsi.com)  
Innovative Technical Solutions, Inc.

**Field Trip Coordinator:**

Rob Nelson,  
[rlngeology@sbcglobal.net](mailto:rlngeology@sbcglobal.net)  
Clearwater Group, Inc.

**Treasurer:**

Phil Reed, [philecreed@yahoo.com](mailto:philecreed@yahoo.com)  
Consultant

**Program Chair:**

Mark Sorensen,  
[msorensen@itsi.com](mailto:msorensen@itsi.com), ITSI

**Scholarship:**

Phil Garbutt,  
[plgarbutt@comcast.net](mailto:plgarbutt@comcast.net)  
Retired, Cal State East Bay

**K-12 Programs:**

John Stockwell,  
[kugeln@peoplepc.com](mailto:kugeln@peoplepc.com)  
Retired, K-12 education

**Membership:**

John Christian,  
[jmc62@sbcglobal.net](mailto:jmc62@sbcglobal.net)  
Patent Legal Assistant

**NCGS Newsletter & Website Editor:**

Mark Detterman  
[mdetterman@blymyer.com](mailto:mdetterman@blymyer.com)  
Blymyer Engineers, Inc.

**Secretary:**

Dan Day: [danday94@pacbell.net](mailto:danday94@pacbell.net)  
NCGS Voice Mail: 925-424-3669  
VA Engineering, Inc.

**COUNSELORS**

Mel Erskine,  
[mcerskine@comcast.net](mailto:mcerskine@comcast.net)  
Consultant

Tridib Guha,  
[Tridibguha@sbcglobal.net](mailto:Tridibguha@sbcglobal.net)  
Advanced Assessment Services, Inc.

Don Lewis, [donlewis@comcast.net](mailto:donlewis@comcast.net)  
Consultant

Ray Sullivan,  
[sullivan@lucasvalley.net](mailto:sullivan@lucasvalley.net)  
Emeritus, San Francisco State  
University

## MEETING ANNOUNCEMENT

**DATE:** November 2008

**PLEASE NOTE - NO MEETING!**

As you will recall, three AAPG Distinguished Lectures have recently been hosted by NCGS; two in November. For this reason there will be no meeting at the usual venue this month.

**Our next meeting will be:**

## *The NCGS 2009 Calendar*

***Wednesday January 28, 2009***

*Geophysical vignettes from the wine country: implications for the northward continuation of the East Bay fault system*

Dr. Victoria E. Langenheim,  
U.S. Geological Survey, Menlo Park, CA  
7:00 pm at Orinda Masonic Center

***Wednesday February 25, 2009***

*Mammoths, Meteorites, and Supernovae*

Dr. Richard B. Firestone, Lawrence Berkeley National Laboratory,  
(Note: Dr. Firestone is co-author of "Cycle of Cosmic Catastrophes"  
– See:

<http://www.innertraditions.com/Product.jmdx?action=displayDetail&id=2139&searchString=1-59143-061-5> or  
<http://www.amazon.com/Cycle-Cosmic-Catastrophes-Stone-Age-Changed/dp/1591430615>)  
7:00 pm at Orinda Masonic Center

***Wednesday March 15, 2009***

Greg Stock

Greg is the Geologist for Yosemite National Park. He will be speaking about rockfalls and / or glaciers in the park.

## *Upcoming NCGS Field Trips*

Rob is working on several potential field trips, not ready for prime time. However, 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 Rob Nelson at:

[rlngeology@sbcglobal.net](mailto:rlngeology@sbcglobal.net)

---

### **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.

---

### **Association of Engineering Geologists** **San Francisco Section**

#### Upcoming meetings

Meeting locations have been rotating between San Francisco, the East Bay, and the South Bay. For further meeting details go to: <http://www.aegsf.org/>. Posted meeting include:

- December 9, 2008; Jeramy Decker, Kiewit Pacific, *Digital Tunnel Scanning and Mapping Technologies*; Location TBA

---

## **"Why Earth Science"**

Last month member **Don Lewis** brought in this **American Geological Institute** (AGI) produced DVD for a pre-talk screening. This is a short six minute long video that supports the importance of K -12 earth science education. For those who were not at the meeting, or for those who want to see it again, you can view the video on YouTube at:

<http://www.youtube.com/watch?v=jxbIJH4fTYo> or on TeacherTube at:

[http://www.teachertube.com/view\\_video.php?viewkey=ccd5e6f96bad182e4311](http://www.teachertube.com/view_video.php?viewkey=ccd5e6f96bad182e4311).

The TeacherTube link has quit a number of

interesting other links for teachers. Both links can be accessed through the AGI webpage supporting the effort:

(<http://www.agiweb.org/education/resource/index.html>). Enjoy browsing!

---

### **Microdocs - A new ecological sustainability educational resource**

Member **Kat Burnham** recently forwarded this announcement as being of potential interest to NCGS members. This effort focuses on coral reefs around the world, but is another effort at providing educational content on the web.

-----

**Dr. Stephen Palumbi** of Stanford University and Garthwait & Griffin films are pleased to announce the launch of the "[Microdocs - Short Attention Span Science Theater](#)" web site. This web site presents a unique combination of web technology and environmental science and is a new way to communicate the wonders and knowledge of science.

For this website, we have created over 30 2-4 minute micro-documentaries. Eye-catching and full of the latest science, each microdoc has been written by leading scientists. Supporting each microdoc is text expanding on the concepts introduced by each film, and links to further reference material. One section lists the National Education Standards and the microdocs that address each point.

The main topic we explore is ecological sustainability - and to do this we take the viewer for a quick trip around **coral reefs** of the world. Reefs from Fiji, Samoa, the Caribbean, Micronesia, and other locations are shown.

The first section asks questions such as: What is sustainability? What promotes it? Threatens it? What are the tipping points that push an ecosystem into ruin or keep it functioning forever? The second section provides examples of the problems facing coral reefs, and how they can recover and grow. This section shows the kinds of reefs, the species that live on them, and the efforts by local people all over the world to preserve them.

The viewer can also control the content flow and the sequence of topics explored in a more informal way. Our videos are imbedded in a web site that allows a user instant streaming access to any video in any order. The videos are arranged in a hierarchy of topics, allowing instant jumping among topics and across hierarchies.

---

## International Year of Planet Earth

Member **Kat Burnham** also forwarded this announcement and links of likely interest to members.

----

Following a [global launch event](#) at the United Nations office in Paris, February 2008, geoscientists around the world are joining together to celebrate the earth sciences during the International Year of Planet Earth (IYPE). This global initiative of the **International Union of Geological Sciences (IUGS)** and the **United Nations Educational, Scientific, and Cultural Organization (UNESCO)** aims to ensure wider use of the knowledge accumulated by the world's earth scientists.

The goal of IYPE is to draw attention to the benefits of the earth sciences for society. Helping to build safer, healthier, and more prosperous societies around the globe is a major theme. Science and outreach activities in 74 participating countries will continue through December 2009.

### Goals of the International Year of Planet Earth

- Reduce risks to society caused by natural and human-induced hazards
- Reduce health problems by improving the understanding of the medical aspects of earth science
- Discover new natural resources and make available in a sustainable manner
- Build safer structures and expand urban areas utilizing natural subsurface conditions
- Determine the non-human factors in climatic change
- Enhance the understanding of occurrences of natural resources in order to contribute to efforts to reduce political tension

- Detect deep and poorly accessible ground-water resources
- Improve the understanding of the evolution of life
- Increase interest in the earth sciences in society at large
- Encourage more young people to study the earth sciences at universities.

### IYPE in the United States

The official [U.S. launch](#) of IYPE took place at the joint meeting of six major geoscience organizations, including GSA, in Houston, Texas, 5-9 October 2008.

The [U.S. National Committee](#) for International Year of Planet Earth is working to raise awareness of IYPE in the United States. The committee is comprised of representatives of 16 U.S.-based geoscience organizations.

A flagship project of the U.S National Committee is an [IYPE Lecture Series](#). Through partnerships with museums, universities, and other science organizations, geoscience lectures and public talks are being held nation-wide through December 2009. View the current list and [submit a lecture](#).

### U.S. National Committee Participating Organizations

- [American Association of Petroleum Geologists \(AAPG\)](#)
- [Association of American State Geologists \(AASG\)](#)
- [Association of Earth Science Editors \(AESE\)](#)
- [American Geological Institute \(AGI\)](#)
- [American Geophysical Union \(AGU\)](#)
- [American Institute of Professional Geologists \(AIPG\)](#)
- [Association of Environmental and Engineering Geologists \(AEG\)](#)
- [Geological Society of America \(GSA\)](#)
- [International Union of Geological Sciences \(IUGS\)](#)
- [National Aeronautics and Space Administration \(NASA\)](#)
- [National Ground Water Association \(NGWA\)](#)
- [North American Committee for Stratigraphic Nomenclature \(NACSN\)](#)
- [Northeastern Science Foundation \(NESF\)](#)
- [Society of Sedimentary Geology \(SEPM\)](#)
- [Soil Science Society of America \(SSSA\)](#)
- [United States Geological Survey \(USGS\)](#)
- [Bruce Museum of Arts and Science](#)

---

# The Asteroid Hunter

*Submitted by Dan Day*

Over the years many speakers have addressed the NCGS. They have represented a variety of disciplines in the geosciences. But perhaps the most provocative lectures have focused on the planetary sciences. Ever since man first cast his gaze upon the skies, he has been captivated by its celestial bodies. Ironically, the Earth and the planets bear the scars of countless collisions with interstellar objects. Astrobiologist **Dr. David Morrison** of the NASA Ames Research Laboratory in Mountain View shed light on these impact phenomena and their evolutionary implications at the February 27, 2008 NCGS Meeting.

Dr. Morrison, currently the Interim Director of the NASA Lunar Science Institute at Ames Research Center, has been a leading figure in the study of extraterrestrial impacts. His presentation *Impacts and Evolution: Astrobiology and Near-Earth Object Impacts* discussed the evolutionary effects of extraterrestrial collisions on our planet, the future risks posed by orbiting bodies, and how impact events have come under serious consideration by our government.

Scientists began to recognize extraterrestrial impacts as potentially serious hazards in the 1980's. The primary impacting bodies are asteroids (meteorites), and presumably comets. At this time NASA was riding high on the success of the Lunar Program, and exploration of the Solar System was being vigorously pursued. The lunar surface itself had been meticulously characterized. Scientists had identified over 30,000 craters on the moon. These blemishes accumulated throughout its existence. The earth fortuitously has an atmosphere, which incinerates many objects that approach its surface. Frictional heating gradients fragment these objects into smaller pieces. Only objects several meters across are able to reach the earth's surface. Scientists now recognize that major impact events were the cause of large-scale mass extinctions in the geologic record. In fact, there is abundant

evidence of recent terrestrial impacts, some in modern times.

One celebrated near-impact event occurred in June, 1908, in the Siberian wilderness. The Tunguska phenomenon was witnessed by a startled peasant farmer, who reported seeing a bright flash in the early morning sky and felt the warmth of a thermal shock wave as it passed by. Later, explorers discovered that forest trees had been leveled like match-sticks over a several hundred square mile area. The eye witness description, the felled tree pattern, and the absence of any associated impact crater suggested an "airburst," or explosion of the incoming object before it impacted the surface, as the cause of this phenomenon. Were a Tunguska-type event to occur over a major urban center today, the results would clearly be catastrophic.

Another puzzling phenomenon was observed in Peru during September, 2007. An apparent low velocity object impact occurred along the muddy shores of Lake Titicaca. A shallow depression was gouged in the soft lakeside sediments. No impact object has yet been recovered, but a meteorite is suspected. Investigations are on-going.

Perhaps the most celebrated impact feature in North America is Meteor Crater near Winslow, Arizona. This well-preserved crater is a veritable classroom for studying impact events. It was also a popular training ground for NASA Apollo astronauts. Information gathered here has been used to confirm other paleo-impact sites.

In 1980 Dr. Luis Alvarez, a Nobel Laureate physicist, hypothesized that a thin iridium-rich Maestrichtian clay seam at the Cretaceous-Tertiary (K/T) boundary recorded a major global impact event that led to the dinosaur extinctions. Iridium is a precious metal that is significantly concentrated in meteors compared with crustal rocks, and thus fingerprints an extraterrestrial source. The Alvarez extinction hypothesis drew substantial criticism, notably because a major Cretaceous-Tertiary impact crater had not been found. Since then, the enormous Chicxulub paleo-crater was discovered at the K/T boundary on the

northwest corner of Mexico's Yucatan peninsula. Impact features have been confirmed there and its origin has been accepted by most of the scientific community

Based on these discoveries and substantial mechanical modeling, Dr. Morrison is convinced that the five major biological extinctions in the earth's history were triggered by cosmic impact events. Each event forced a rapid temporal change in floral and faunal species, followed by major re-speciation of the vacated evolutionary niches. For instance, across the K/T boundary, only 10% of the pre-existing planktonic foraminifera species survived.

Detailed studies of meteorite impacts provide the following probable scenario for the Chicxulub impact. The impacting object was a solid asteroid-type mass about 10 to 15 km in diameter. The impact ejecta underwent atmospheric heating as it settled earthward, igniting vegetation and creating a global firestorm that eradicated most of the planet's food sources. Fine dust particles were suspended in the atmosphere and triggered a "global winter" similar to, but presumably more long-lived than, the spectacular events that accompanied the 1883 Krakatoa volcanic eruption. At this time the earth's climate had been in a prolonged warm period. The sudden global cooling that would have followed the Chicxulub meteor impact sealed the fate of the dinosaurs.

The post-K/T evolutionary adjustments show the resilience of the earth's biological community. Under steady state conditions, life will follow the classic "survival of the fittest" evolutionary model. But mass extinctions confound the situation and open up numerous biological niches for occupancy. It is nature's ultimate "open house." The survivors of these global disasters were able to populate the niche that best suited them.

In 1991, a Congressional Statement was issued by the House Committee on Science and Technology expressing a critical need to identify and track asteroids in the Solar System. The request specifically noted that the extraterrestrial objects should be detected and

tracked so that their orbits can be defined and the probability of terrestrial impact calculated. If a collision course was imminent, guidelines to avoid a catastrophe were to be developed and implemented.

Comets and asteroids are the two celestial bodies of concern. Asteroids are planetary debris orbiting the Sun in a diffuse path between Earth and Mars. They are thought to be the shattered remains of a planet. Asteroids are substantially more common than comets, whose orbits take them far beyond the Solar System. Comets are agglomerations of ice, dust, and rocky particles that originate in a cloud of material outside the Solar System. They are thought to be the remains of the Solar Nebula. Because of their abundance and close proximity, asteroids are considered to be much higher impact risks than comets. Some have irregular, oblong shapes. Like the Moon, the larger ones are also cratered.

Calculating extraterrestrial impact frequency is a function of object size and the impact energy. It is notable that "explosive" events such as volcanic eruptions, extraterrestrial impacts, and even nuclear detonations follow exponentially decreasing recurrence intervals scaled according to the energy release per event. Impacts and explosive events with massive energy yields are much less common than smaller ones; hence, their probability of occurring is much lower. Events that triggered mass extinctions have recurrence intervals of several hundred million years. Tunguska magnitude events occur on hundred-year time scales. Acquiring reliable evidence to support these statistics requires some clever scientific sleuthing.

Dr. Morrison discovered that the U.S. military had been tracking explosive events for weapons proliferation treaty enforcement during the Cold War. This program also captured airburst explosions. The data acquisition software used by the military was designed to record, but not to count these bursts as nuclear detonations. The Tunguska airburst is estimated to have been a 10 to 15 megaton explosion. To trigger a global catastrophe, such as the Cretaceous-Tertiary mass extinctions, a one million megaton event is required. The probability of

such a global catastrophe occurring in a human lifetime is one in 50,000 (a one in 4 million risk per year). The effects of a global catastrophe far exceed those of any other known disaster. Consequently, the average time interval between such events is much greater than for common natural disasters.

To accurately estimate the impact frequency of an event that created Arizona's Meteor Crater requires knowing how many objects capable of producing a crater that size are in the Solar System. The orbital paths of these objects also influence their impact frequency. Dr. Morrison's team began aggressively looking for various size asteroid objects in the mid-1990's. The researchers used a one meter diameter linear telescope in New Mexico equipped with a computerized CCD camera programmed to track and image moving objects. Aircraft and satellites were ignored. To essentially eliminate the risk of a catastrophic terrestrial impact, 99% of the threatening objects must be identified. Dr. Morrison's goal was to find 90% of the existing near earth asteroids over one kilometer in diameter and plot their orbits by 2008. The object discovery rate showed a significant reduction when about 700 asteroids had been found. Dr. Morrison noted that the discovery rate will drop off quickly after a significant number of objects have been located because the objects are becoming progressively smaller and harder to spot, and the objects that have already been identified are confounding the search. Once 90% of these objects have been discovered, it will be considerably more expensive to detect the next 9% to reach the 99% confidence level. The National Academy of Sciences now wants to extend the near earth asteroid search down to the 200 meter size range! To achieve this milestone, the research team has proposed using a more sensitive large synoptic survey telescope.

Through February 2008, NASA had discovered one near earth asteroid that could be considered a potential impact threat. The asteroid, named Apophis, will have a historically close approach to earth in 2029. It was originally considered to have a 2.7% impact chance that year, but additional studies downgraded that prediction to a "close encounter." It currently has less than a

1 in 45,000 chance of collision on April 13, 2036 with a probable impact zone spread between Greenland and the Philippines. The prognosis of that event may change depending on the effects of the 2029 close encounter. Predicting impact probabilities for small object like this (700 to 1100 feet in diameter) are highly influenced by the gravitational effects of the large planets and other asteroids. Presently it may be concluded that Apophis is an object that needs to be watched, and that its ultimate fate will be better understood in about twenty years.

Dr. Morrison concluded with some commentary on defenses against potential asteroid impacts. The obvious best defense against a high risk impact would be to change the object's orbit. Ballistic impacts and nuclear detonations are the accepted best methods for accomplishing this task. Depending on the object size, a missile impact could be successful. A nuclear detonation was championed by the late Dr. Edward Teller, Father of the Hydrogen Bomb and a noted nuclear weapons proponent. Certainly some of the largest nuclear weapons, like the enormous 100-Megaton Russian bomb fabricated in Shnezinsk in 1994, could obliterate a threatening Apophis-size asteroid. Such concepts have not escaped the musings of other astronomers and planetary scientists. Carl Sagan once noted that these protective strategies could also be used to create an impact. If a real threat were to arise, man would be faced with a moral dilemma: should we deflect the object, and tamper with natural evolution, or should man face potential extinction? With no known impact event facing our planet in the near future, there is ample time to ponder these issues and seek a satisfactory solution.

In post-presentation discussions, Dr. Morrison commented that man's current greatest threat is Global Warming. He mentioned that all the near earth asteroids are inside the Asteroid Belt between Earth and Mars, and that about 25% of these objects will eventually approach our planet. However, the size limit on objects that will reach the surface is 30 meters (100 feet). The earth's surface was heavily impacted during its first 500 million years, before a significant atmosphere had formed. In the last 3 billion

years the impact rate has decreased and stabilized. The lunar impact rate can be calculated by counting craters on the 3 billion year old Mare flood basalts.

For more information on NASA's near earth object program, go to [www.neo.jpl.nasa.gov](http://www.neo.jpl.nasa.gov). Coincidentally, the Tunguska event is celebrating its Centennial this year. To learn more about it, Google Tunguska and select the appropriate links.

The NCGS expresses its sincerest gratitude to Dr. David Morrison of NASA Ames Research Center for a very entertaining and thought provoking talk on extraterrestrial object impacts, their influence on the evolution of life, and the potential threat they pose to society. Mankind can sleep easier knowing that our best astronomers are keeping a watchful eye on the skies for celestial intruders.

---

## **Bounce Bounce**

### **This Week in SCIENCE**

#### **October 31 2008**

Buildings in seismic zones need to be designed to maintain integrity during strong shakings. Recent instrumentation is now revealing unexpected dynamics close to earthquake epicenters. *Aoi et al.* show that ground acceleration exceeded 4 times gravity in a recent magnitude 6.9 quake in Japan. Interestingly, the upward acceleration was greater than the downward one. The authors explain the signal with a model of a shallow soil layer bouncing on a trampoline formed by the underlying crust. This high of an acceleration and dynamics poses challenges in earthquake design.

---

## **Mantle Flow**

### **This Week in SCIENCE**

#### **November 7 2008**

Seismic data provide an image of Earth's mantle today. Geologic data from mountain belts or sedimentary records in basins record the overall effects of mantle flow, but may not reveal the actual flow patterns. Starting with these observations, plus estimates of mantle

properties, *Liu et al.* have developed a model of the evolution of western North America during the past 100 million years. The model is consistent with flat subduction of the Farallon oceanic plate beneath the continent during much of this time, but shallow subduction extended over a larger area, which could explain a broad Cretaceous unconformity in sedimentary records.

---

## **CLIMATE SCIENCE**

### **Warming Vapors**

#### **Editors' Choice:**

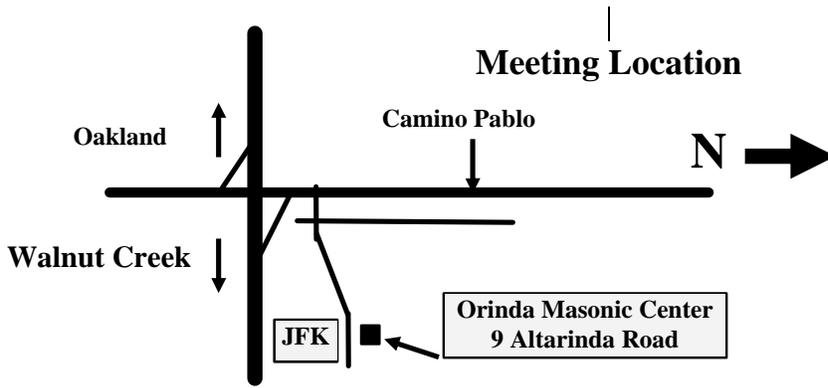
#### **Highlights of the recent literature**

#### **November 7 2008**

Water vapor is the atmospheric gas that collectively has the greatest greenhouse effect on climate, although it does not directly instigate warming or cooling trends, because the amount of water vapor in the atmosphere varies only in response to temperature change. Instead, water vapor only amplifies temperature trends being caused by other factors such as atmospheric CO<sub>2</sub> concentration or Earth's albedo. The extent to which humidity changes in response to temperature variation is therefore a key parameter in global climate models, because that quantity determines the strength of the associated warming or cooling. Dessler *et al.* present satellite data from 2003 to 2008 which show that models have gotten that relationship correct, and that relative humidity is effectively constant at any given temperature. Thus, the temperature increases predicted by global models are virtually guaranteed to be several degrees Celsius by the year 2100. Knowing the water vapor content of a warmer atmosphere is also important for predicting rainfall and storminess.

*Geophys. Res. Lett.* **35**, L20704 (2008).

---



**Please Note –  
If your NCGS membership has not been renewed  
recently, it's overdue!!**

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 **Dan Day** at [danday94@pacbell.net](mailto:danday94@pacbell.net) to sign up for this free service.