



Spring 2011 Conference National Association of Geoscience Teachers Far-Western Section

*Hosted by the Tectonics Observatory, California Institute of Technology
Pasadena, CA*

Friday – Sunday, March 25 – 27, 2011

Conference website: <http://www.tectonics.caltech.edu/meetings/nagt>

Co-Coordinator:

Jeff Grover
Cuesta College
San Luis Obispo, CA 93403-8106
(805) 546-3100 x2759
jgrover@cuesta.edu

Laurie Kovalenko, Education and Public Outreach
Tectonics Observatory, Caltech
Mail Code 100-23
Pasadena, CA 91125
(626) 395-6023
lauriek@gps.caltech.edu

Overview:

We have a diverse offering of trips this year that cover a wide range of Earth Sciences. Field trips and workshops will introduce participants to recent developments in tectonics, geochemistry, seismology, petrology and geomorphology.

1.5 CEU (continuing education units) will be available for participants through USC's Rossier School of Education.

Mike Lamb will lead a trip to examine erosion and sediment transport close to home by hiking up Arroyo Seco into the burned zone just behind JPL. A trip led by Bruce Carter will examine the Precambrian Anorthosite exposures in the San Gabriel Mountains. These rocks are intriguingly similar to some Moon rocks collected by Apollo astronauts. Participants on this trip will also visit the San Andreas Fault near Palmdale. Elisabeth Nadin with Rebecca Walker will take a group to Vasquez Rocks to view evidence of its creation some 25 million years ago. And Donald Prothero will lead a trip to Devil's Punchbowl and Red Rock Canyon, focusing on sedimentary sequences and fossil mammals.

Taking advantage of the Caltech venue, we are offering a variety of workshops on state-of-the-art research. Caltech professors Ken Farley, John Eiler, and Brian Wernicke team up to demonstrate how modern geochemical analyses are used to date the landscape formation including the Grand Canyon! Joann Stock, also a Caltech professor, will lead participants in hands-on activities to better understand earthquake magnitudes and those strange "beach ball" symbols commonly shown on seismicity maps. Tanya Atwater, emeritus professor at UCSB will show how tectonics shaped Southern California using both animations and hands-on construction of tectonic models. Elisabeth Nadin from UA/Fairbanks and Belle Philibosian from Caltech will lead participants in the analysis of coral data to uncover the ancient earthquake and tsunami record in Sumatra Indonesia. Last but not least, Caltech Professor Tom Heaton and Ming-Hei Cheng will demonstrate how the current seismic network of 200 stations is being expanded to over a million via seismometers on personal computers.

There will also be two evening talks: *Vibrations Inside the Earth* by Jennifer Jackson (Caltech), and another by Jess Adkins (Caltech). We'll also have a tour of the Caltech Seismo Lab.

Schedule:

Friday, March 25		
Time	Event	Location
4:00 – 7:00 pm	Registration, Hors d'oeuvres, SCEC display	Arms, First floor
5:00 – 6:00 pm	Tour of Seismo Lab - <i>Margaret Vinci (Caltech)</i>	South Mudd, First floor
6:15 – 6:45 pm	Presentation: Recent Earthquake in Japan – <i>Tom Heaton (Caltech)</i>	Arms, Sharp Lecture Hall
7:00 – 8:30 pm	Evening presentation: Good Vibrations Inside the Earth - <i>Jennifer Jackson (Caltech)</i>	Arms, Sharp Lecture Hall
8:30 – 9:00 pm	Section Business Meeting	Arms, Room 151

Saturday, March 26		
Time	Event	Location
6:00 – 8:00 am	Continental breakfast and box lunch pick-up	Winnett Lounge
8:00 – 5:00 pm	Full-day field trips <i>OR</i> Half-day workshops (8:00 am - 11:30 am) & half-day field trips/workshops (12pm - 5pm) Coffee break (10:15 am) Snack break (2:30 pm)	Trips meet outside South Mudd Workshops in N and S Mudd
6:00 – 8:00 pm	Banquet catered by El Portal (separate fee includes dinner, beer, and wine)	Winnett Lounge
8:00 – 9:00 pm	Evening presentation – Journey to the Bottom of the Sea: how corals calcify and why we care - <i>Jess Adkins (Caltech)</i>	Winnett Lounge

Sunday, March 27		
Time	Event	Location
7:00 – 8:00 am	Breakfast Omelet Bar	Arms
9:00 – 12:00 pm	Half-day workshops Coffee break	N Mudd, S Mudd, Millikan

Choose one option for Saturday field trips and workshops:

- **Option 1:** San Gabriel Anorthosite and San Andreas Fault full-day field trip - *Bruce Carter (PCC)*
- **Option 2:** Devil's Punchbowl and Red Rock Canyon full-day field trip - *Donald Prothero (Occidental College)*
- **Option 3:** Earthquake magnitude, energy, and focal mechanisms (beach balls) half-day workshop - *Joann Stock (Caltech)* AND Erosion and sediment transport in steep mountain terrain, San Gabriel Mountains half-day field trip - *Mike Lamb (Caltech)*
- **Option 4:** Earthquake magnitude, energy, and focal mechanisms (beach balls) half-day workshop - *Joann Stock (Caltech)* AND Vasquez Rocks half-day field trip - *Elisabeth Nadin (UA/Fairbanks)* and *Rebecca Walker (Mt SAC)*
- **Option 5:** Low-T thermometry and thermochronometry and applications (including dating the formation of the Grand Canyon) workshop - *Ken Farley, John Eiler, and Brian Wernicke (Caltech)* AND Erosion and sediment transport in steep mountain terrain, San Gabriel Mountains half-day field trip - *Mike Lamb (Caltech)*
- **Option 6:** Low-T thermometry and thermochronometry and applications (including dating the formation of the Grand Canyon) half-day workshop - *Ken Farley, John Eiler, and Brian Wernicke (Caltech)* AND Vasquez Rocks half-day field trip - *Elisabeth Nadin (UA/Fairbanks)* and *Rebecca Walker (Mt SAC)*
- **Option 7:** Earthquake magnitude, energy, and focal mechanisms (beach balls) half-day workshop - *Joann Stock (Caltech)* AND Operations of Community Seismometer Network (How your laptop can help scientists better understand earthquakes) workshop - *Tom Heaton and Ming-Hei Cheng (Caltech)*
- **Option 8:** Low-T thermometry and thermochronometry and applications (including dating the formation of the Grand Canyon) half-day workshop - *Ken Farley, John Eiler, and Brian Wernicke (Caltech)* AND Operations of Community Seismometer Network (How your laptop can help scientists better understand earthquakes) workshop - *Tom Heaton and Ming-Hei Cheng (Caltech)*

Choose one option for Sunday workshop:

- **Option 1:** (*moved to Saturday*)
- **Option 2:** Historical earthquakes and uplift/subsidence of Sumatra from coral growth rings - *Elisabeth Nadin (UA/Fairbanks)* and *Belle Philibosian (Caltech)*
- **Option 3:** Plate Tectonic Rotation of the Transverse Ranges: what happened, how we know it happened, and how it created Southern California's unique geography, climate, ocean currents and biological richness – *Tanya Atwater (UCSB)*
- **Option 4:** Earthquake magnitude, energy, and focal mechanisms (beach balls) half-day workshop - *Joann Stock (Caltech)*

Field Trip Descriptions:

Field Trip 1: San Gabriel Anorthosite and the San Andreas Fault

Bruce Carter (PCC)

Saturday 8 am – 5 pm

Participants on this trip will observe typical rocks of the Precambrian anorthosite-syenite body in the western San Gabriel Mountains. Almost completely burned over by the station fire last year, access is limited, but we will see several of the typical lithologies of this body and discuss the origin of anorthosite and related rocks found in many ancient terrains around the world.

The trip will continue northward to observe selected features along the Palmdale segment of the San Andreas Fault. Participants will observe fault-line features produced in the 1857 Fort Tejon earthquake, offset patterns of Mesozoic rocks and discuss the history of early studies of the fault and the next 50 years that brought growing recognition of its tectonic significance in shaping the geology of North America.

Field Trip 2: Devil's Punchbowl and Red Rock Canyon

Donald Prothero (Occidental College)

Saturday 8 am. - 5 pm

On this trip, we will focus on the sedimentary rocks of the northern Transverse Ranges and Mojave Desert, the tectonics responsible for their deposition and deformation, and the fossil mammals and other methods that give us age constraints for all these events. After a brief stop at Vasquez Rocks to see the tilted and rotated beds of the Soledad Basin, we will stop at Devil's Punchbowl State Park to see tightly folded late Miocene sedimentary rocks right next to the San Andreas fault. After lunch, we will drive up through the western Mojave Desert to visit Red Rock Canyon State Park, where a thick sequence of middle-late Miocene sedimentary rocks is world famous for its scenery and fossils. Featured in many movies (such as "Jurassic Park"), the Red Rock Canyon sequence has been very carefully dated by many methods (radiometric dating, magnetic stratigraphy), and is a product of remarkable tectonics in the Garlock fault region.

Field Trip 3: Erosion and sediment transport in steep mountain terrain, San Gabriel Mountains (Half-day trip)

Mike Lamb (Caltech)

Saturday 12 pm – 5 pm

On this trip, we will hike up the lower Arroyo Seco River and into the burned area of the extensive 2009 Station Fire. We will discuss how rivers transport large boulders and a worksheet will be handed out to make calculations for predicting boulder motion. We will also discuss debris flow hazards, debris flow initiation mechanisms, and the landscape response to fire.

Hike: The hike will be about 2 miles on steep and uneven terrain. Depending on water levels and the condition of the trail, a river crossing may be necessary. Wear comfortable shoes or hiking boots.

Field Trip 4: Vasquez Rocks (Half-day trip)

Elisabeth Nadin (UA/Fairbanks) and Rebecca Walker (Mt SAC)

Saturday 12 pm – 5 pm

Named after one of California's most notorious bandits who hid out here in 1873, Vasquez Rocks is a geologist's playground. The Oligocene Vasquez Formation was deposited as Soledad Basin underwent extension along detachment faults southwest of the Orocochia Mountains. Tilted sequences of red conglomerates to fine-grained sandstones are made of eroded San Gabriel Mountains crystalline basement. During this half-day field trip, we will identify alluvial megacycles in Vasquez Rocks State Park, where the formation reaches its maximum thickness of 5,500 meters. We will examine different clast compositions and discuss the regional geologic setting that produced this spectacular rock formation.

Workshop Descriptions:

Workshop 1: Low-T thermometry and thermochronometry and applications (including dating the formation of the Grand Canyon)

Ken Farley, John Eiler, and Brian Wernicke (Caltech)

Saturday 8:30 am – 11:30 am

The allied fields of geomorphology and paleoaltimetry are rapidly advancing owing to new geochemical techniques that measure paleotemperatures of common rock-forming minerals. In this three-part workshop, Ken Farley will provide an up-to-date overview of low-temperature thermochronometry using the (U-Th)/He method, then John Eiler will discuss the nuts and bolts of carbonate "clumped-isotope" thermometry. In the last part, Brian Wernicke will discuss how these methods have been combined and applied to the classic problems of the time of incision of the Grand Canyon, and the age of uplift of the Colorado Plateau.

Workshop 2: Earthquake magnitude, energy, and focal mechanisms (beach balls)

Joann Stock (Caltech)

Saturday 8 am – 11:30 am

In this hands-on workshop we will explore how seismologists generate the familiar "beach ball" figures that are used to portray the type of rupture during an earthquake. We will review and practice the basics of the lower-hemisphere stereographic projection, and learn how seismic-wave first-motion arrivals from an earthquake can be mapped onto this projection in order to define the fault plane and the auxiliary slip plane for the displacement during the earthquake.

Each participant will then have the chance to use a sample set of seismic waves from global stations to construct a first-motion focal mechanism. By the end of the workshop, each participant should have a good understanding of what "beach ball" diagrams mean, in terms of the geometry of the fault that slipped to cause the earthquake. We will also use the seismograms to discuss how seismologists determine earthquake magnitude and earthquake moment, at a level suitable for use in introductory college-level earth science classes.

Workshop 3: Operations of Community Seismometer Network (How your laptop can help scientists better understand earthquakes)

Tom Heaton and Ming-Hei Cheng (Caltech)

Saturday 1 pm – 4:30 pm

This workshop will describe new technologies to record earthquake shaking and to respond to earthquakes even as they are occurring. We will demonstrate how to deploy inexpensive seismometers that are operated by volunteers and connected to seismic networks using the Internet. We will also show new early warning technology, currently under development, to rapidly learn where an earthquake has initiated and where waves will arrive soon after. We will explore how earthquakes affect different types of buildings and take a short trip up to the top of Caltech's nine-story Millikan library where we will generate earthquake-like vibrations and see (and feel!) how the building responds. And we will learn how to use several earthquake analysis tools that are available through the Internet.

Workshop 4: Historical earthquakes and uplift/subsidence of Sumatra from coral growth rings

Elisabeth Nadin (UA/Fairbanks) and Belle Philibosian (Caltech)

Sunday 9 am – noon

The Sumatra region is prone to earthquakes because it lies at the boundary of two of Earth's shifting tectonic plates—the Indian Ocean crust is creeping steadily northeast and subducting beneath Sumatra. The steady horizontal movements, as well as the pulses of faster horizontal motion that occur during earthquakes, are recorded by GPS stations on the islands. But GPS has only been around since the 1980s, so it can't tell us about land motions associated with large earthquakes that happened in Sumatra long ago. GPS also lacks precise information on vertical motions, and cannot be installed under water, so GPS measurements of coastal land movements are incomplete.

In order to figure out how often large earthquakes happen in the Sumatra region, scientists have turned to coral micro-atolls. They also use coral records to reconstruct progressive sea level changes. In this workshop we will use data from real corals collected in Sumatra to track the sea level and earthquake record of the region over the past century. Teachers will then be able to use this exercise with their students.

Workshop 5: Plate Tectonic Rotation of the Transverse Ranges: what happened, how we know it happened, and how it created Southern California's unique geography, climate, ocean currents and biological richness

Tanya Atwater (UCSB)

Sunday 9 am – noon

In this workshop, we will explore the plate tectonic development of the San Andreas Fault plate boundary in Southern California and its affects on many aspects of our natural systems. First we will use animations, maps, field images, and a physical model to examine the plate boundary evolution and to see how it produced our unique present-day geography and topography, with special emphasis on the rotation of the Transverse Ranges block. Next we will explore some evidence that convinced geoscientists that the rotation occurred, including the rotation of paleo-magnetic vectors and the odd occurrences and arrangements of some very unusual rocks (Poway conglomerate and San Onofre breccia). Finally, we will examine

how our funny geography causes our special climates, our unusual offshore oceanographic circulation patterns, and our extra rich marine biological diversity and productivity.

Tour Description:

Seismo Lab Tour

Margaret Vinci (Caltech)

Friday 5:00 pm – 6:00 pm

During your tour of the Caltech Seismological Laboratory you will be able to see the operations and media centers. Learn what scientists do when an earthquake occurs and how the information is distributed to the public. Tour the Beowulf Supercomputer cluster used to do earthquake simulations involving tens of millions of operations per second producing a model that can be compared to a CAT scan of the Earth. You will hear about the history of seismic monitoring in southern California since the early 1920's, development of earthquake products and tools for critical users of earthquake information, current research and community outreach and educational programs. A highlight of the tour will be our newly installed San Andreas Fault Peel exhibit which is an extracted portion of the San Andreas Fault in the Pallet Creek area depicting the 1812 and 1857 earthquake offsets.

Hotels/Motels within walking distance of campus:

<p>Saga Motor Hotel 1633 E. Colorado Blvd. Pasadena, CA 91106 (626) 795-0431</p>	<p>We have reserved a block of rooms at the Saga Motor Hotel, which is within walking distance of the Caltech campus; these will be held through March 3. To receive the special NAGT rate (\$77 + tax one bed; \$79 + tax two beds), you'll need to call and let them know you are with NAGT</p>
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[Vagabond Inn](#)

1203 E. Colorado Blvd.
Pasadena, CA 91106
(626) 449-3170
Caltech rate: \$77+tax

Hotels within a short distance to Caltech (2-3 miles):

[Best Western Pasadena Inn](#)

3570 E. Colorado Blvd.
Pasadena, CA 91107
(626) 796-9100
Caltech rate: \$67 total including tax for one bed; \$80 total including tax for two beds

More options for accommodations can be found at:

<http://www.admissions.caltech.edu/visiting/accommodations>

Registration Form

Payment of registration fees provides the following: admission to the conference and conference guidebook; Friday evening social with hors d'oeuvres, Seismo Lab tour, and evening presentation; Saturday breakfast, box lunch, field trips, workshops, and post-banquet presentation; Sunday breakfast and workshops. *PLEASE NOTE: Separate fee is required for the Saturday night banquet.*

1.5 CEU (continuing education credit) will be available at an additional fee of \$65. *TEACHERS PLEASE NOTE: For continuing education credit, check in advance with your district's personnel officer to ensure credit satisfies your district's requirements.*

Name: _____

Address: _____

State: _____ Zip: _____ Phone: _____

Email address (required for registration confirmation): _____

School affiliation/Employer: _____

Occupation: ___ Teacher (K-12) ___ Teacher (college) ___ Student ___ Other

Friday Events *(Please check events you plan to attend):*

___ Registration check-in and social (4:00 – 7:00)

___ Tour of Seismo Lab

Saturday Field Trips and Workshops:

Please indicate your 1st through 6th choices. We will do our best to assign you your first choice. Space is limited so REGISTER EARLY!

___ **Option 1:** San Gabriel Anorthosite and San Andreas Fault full-day field trip

___ **Option 2:** Devil's Punchbowl and Red Rock Canyon full-day field trip

___ **Option 3:** Earthquake Magnitude, Energy, and Focal Mechanisms (beach balls) workshop & Erosion and Sediment Transport field trip

___ **Option 4:** Earthquake Magnitude, Energy, and Focal Mechanisms (beach balls) workshop & Vasquez Rocks field trip

___ **Option 5:** Low-T Thermometry and Thermochemistry workshop & Erosion and Sediment Transport field trip

___ **Option 6:** Low-T Thermometry and Thermochemistry workshop & Vasquez Rocks field trip

___ **Option 7:** Earthquake Magnitude, Energy, and Focal Mechanisms (beach balls) workshop & Operations of Community Seismic Network workshop

___ **Option 8:** Low-T Thermometry and Thermochemistry workshop & Operations of Community Seismic Network workshop

Sunday Workshops (Please indicate your 1st, 2nd, and 3rd choices):

_____ **Option 1** (moved to Saturday)

_____ **Option 2** Historical Earthquakes and Uplift/Subsidence of Sumatra from Coral Growth Rings workshop

_____ **Option 3** Plate Tectonic Rotation of the Transverse Ranges: what happened, how we know it happened, and how it created Southern California's unique geography, climate, ocean currents and biological richness workshop

_____ **Option 4** Earthquake Magnitude, Energy, and Focal Mechanisms (beach balls) workshop

Meals:

Friday evening hors d'oeuvres

Saturday

- Continental breakfast
- Box lunch with drinks (please choose one):
 _____ Ham _____ Turkey _____ Roast Beef _____ Vegetarian
- Evening banquet in Winnett Lounge, catered El Portal (separate fee includes dinner, beer, and wine); check here for vegetarian: _____

Sunday breakfast omelet bar

Registration Options:

Early registration (postmarked by February 14)	\$85	
Registration (postmarked by February 25 March 11)	\$95	
Late or on-site registration (space permitting)	\$125	
Student registration (<i>For full-time students only. Please send photocopy of student ID along with registration form</i>)	\$50	
Saturday night banquet	\$35	
1.5 CEU (Continuing Education Units) - to receive credit, please send CEU application form (next page) along with registration form	\$65	
Make checks payable to Caltech Mail to: Laurie Kovalenko California Institute of Technology MC 100-23 Pasadena, CA 91125	Total Remittance:	

Note for teachers: For continuing education credit, check in advance with your district's personnel officer to insure credit satisfies your district's requirements.

Questions? Contact Laurie Kovalenko at lauriek@gps.caltech.edu (626) 395-6023
Or Jeff Grover at jgrover@cuesta.edu (805) 546-3100 x 2759



A multidisciplinary center for observing, measuring,
and modeling the dynamics of the lithosphere



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lauriek@gps.caltech.edu

**National Association of Geoscience Teachers
Spring 2011 Meeting of the Far-Western Section
Friday, March 25, 2011 to Sunday, March 27, 2011**

CEU Application Form

PERSONAL INFORMATION

NAME		SOCIAL SECURITY #	
HOME ADDRESS			
CITY	STATE	ZIP CODE	
EMAIL	PHONE #	FAX #	

WORK/SCHOOL INFORMATION

SCHOOL NAME		DISTRICT	GRADE
SCHOOL ADDRESS			
CITY	STATE	ZIP CODE	
EMAIL	PHONE #	FAX #	

COST & CONSENT

The Cost for 1.5 CEUs is \$65.00

Submit registration form to:

Laurie Kovalenko
California Institute of Technology
Tectonics Observatory
1200 East California Blvd., MC-100-23
Pasadena, CA 91125-2300

Your signature acknowledges that you are to receive 1.5 Continuing Education Units. These are NOT graduate units, semester units or salary points.

Signature: _____

Date: _____

Verification of Completion

Signature: _____

Date: _____