spring 2009

earthscope onSite newsletter

PUBLIC OUTREACH EDITION

From the EarthScope Education and Outreach Subcommittee

The public is a valued partner in EarthScope. Many members of the public actively participate by hosting a seismometer or a GPS monument on their private land. This special aspect strengthens the Education and Outreach (E&O) component of EarthScope, which has a two-fold purpose: (1) to serve the public's needs for information about EarthScope, and (2) to take advantage of the unique educational opportunities afforded by public participation.

There are many ways for scientists and the public to receive information about EarthScope. In addition to *onSite* and the web site, EarthScope sponsors interactive computer kiosks dedicated to the "Active Earth" at museums and visitor centers in state and national parks. These kiosks provide hands-on information about EarthScope and how it helps us investigate dynamic Earth processes. The EarthScope Speaker Series brings scientists to colleges and universities around the country to deliver open lectures about science results. EarthScope organizes workshops whereby scientists work with park rangers and museum educators to bring the excitement of EarthScope observations and science results to the public. Researchers also work with E&O specialists to design units for K-12 Earth science curricula and to develop new ways for data visualization.

The scientists and educators of the EarthScope Education and Outreach Subcommittee (EEOSC) welcome comments and suggestions to help them plan and guide the development of products and training that benefit scientists, teachers, students, and the public. Please use our online form at www.earthscope.org/contacts or refer to our conact information on the back page.

Jim Davis

James L. Davis, EEOSC Chair

featured science:

Yellowstone National Park: The Recent Earthquake Swarm

Just after Christmas, National Park Service employees and visitors to Yellowstone National Park were really quivering – not only from the cold temperatures, but also from earthquakes! Nearly 1,000 earthquakes occurred between December 26, 2008, and early January 2009. While earthquake swarms are common in and around Yellowstone National Park, the number of earthquakes in this recent swarm was well above average.

Yellowstone National Park sits above a large, active volcanic-tectonic system that has had several major eruptions. The last giant eruption occurred about 640,000 years ago. Since then, more than 30 smaller lava flows have erupted, including one as recently as 70,000 years ago. The last super eruption created a 37-mile by 25-mile (60-km by 40-km) caldera, or large depression, that is located in the center of the park. Scientists have been able to seismically image the volcano's partially melted magma chamber that exists 5-10 miles (8-16 km) below the surface and provides the heat for thousands of geysers, hot springs and fumaroles found within the park and the surrounding area. This volcanic system is superimposed on pre-existing north-south trending mountain ranges with intervening valleys that formed as a result of large magnitude earthquakes along major faults.

Stresses on the Earth's crust from tectonic forces as well as stress related to the volcanic system are responsible for Yellowstone's earthquakes. The area has one of the highest rates of seismicity in the western US, experiencing 1,000 to 3,000 earthquakes in a typical year, including the largest historic earthquake of the Intermountain West – a magnitude 7.5 event in 1959, near West Yellowstone, Montana. Swarms are earthquakes that occur close in time and space without a pronounced main event and are the most common process for releasing stress in the Yellowstone area. Records show there were 69 swarms in Yellowstone between 1984 and 2006.

As shown in Figure 1, the most recent swarm occurred two to six miles (3 to 10 km) beneath Yellowstone Lake. It began southeast of Stevenson Island and migrated northward over time toward Fishing Bridge. There were 18 earthquakes with magnitudes greater than 3.0 and about 111 earthquakes with magnitudes greater than 2.0. The largest earthquake occurred on Sunday, December 28, and had a magnitude of 3.9. At the north end of Yellowstone Lake, people reported feeling several of the larger earthquakes. The energy released from the swarm was equal to the energy released by a single magnitude 4.5 earthquake. The earthquake swarm has not yet caused any discernable change in the surface thermal features at Yellowstone or any obvious ground deformation, however, the area is under many feet of snow. Based on analyses of the recorded seismic signals, scientists believe the seismicity was related to hydrothermal and tectonic processes.

(continued on page 3)

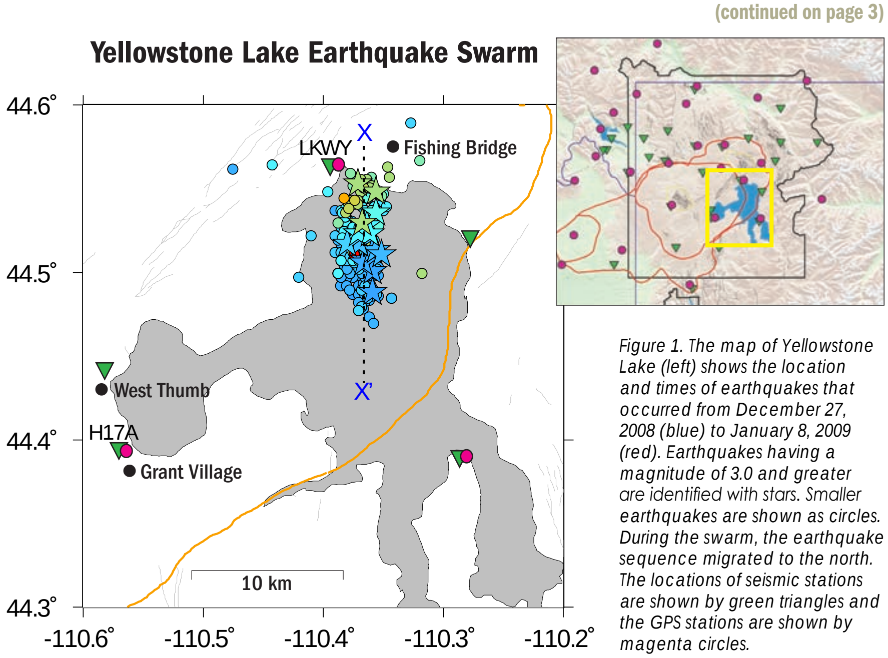


Figure 1. The map of Yellowstone Lake (left) shows the location and times of earthquakes that occurred from December 27, 2008 (blue) to January 8, 2009 (red). Earthquakes having a magnitude of 3.0 and greater are identified with stars. Smaller earthquakes are shown as circles. During the swarm, the earthquake sequence migrated to the north. The locations of seismic stations are shown by green triangles and the GPS stations are shown by magenta circles.

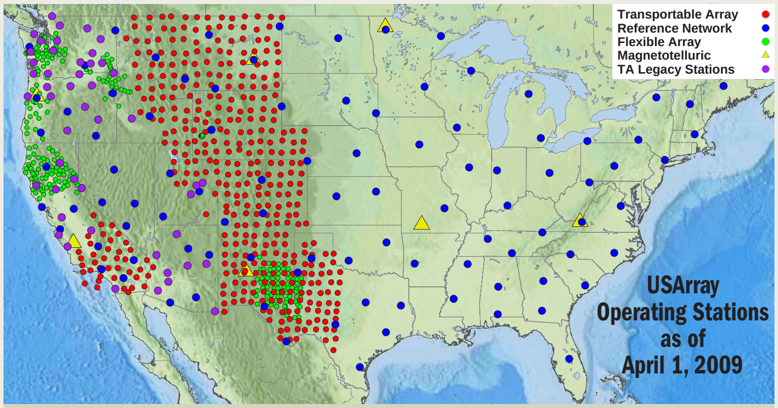
EarthScope: overview and project status

The goals of the EarthScope program are to understand the evolution of the North American continent and the physical processes that control earthquakes and volcanic eruptions. All data are freely available online to scientists, students, and the public. In addition, EarthScope offers a centralized forum for Earth science education at all levels and an excellent opportunity to develop cyberinfrastructure to integrate, distribute, and analyze diverse data sets. Updates on the status of the three facilities are presented here. If you are new to EarthScope, please visit http://www.earthscope.org/observatories for additional background on the facilities. ■

project status: USArray

The Transportable Array continues to slowly make its way across the US. As it rolls eastward at a rate of about 200 stations a year, a similar number of stations are removed from the western edge. Despite inclement weather, fewer hours of daylight, and time off during the holiday season, the hard-working field crews have been able to keep up the pace. Over the past six months, more than 90 new earthquake recording stations were installed in Montana, Wyoming, Nebraska, Colorado and Texas, while stations in Washington, Oregon, Idaho, Nevada, Utah, and Arizona were decommissioned after having completed their two years of service at those sites.

The equipment from most of these decommissioned stations is removed for installation at a new station on the eastern edge of the array. However, in some cases and only with permission from the landowner, a number of stations have been "adopted" by a local university, an existing seismic network or a state agency for the cost of the equipment in the vault. These "adopted" stations continue to operate, providing data for educational purposes, expanded seismic monitoring, or risk assessment studies. Thus far, about 40 stations in the western US have been adopted. To learn more about the Adopt-A-Station program, visit http://www.iris.edu/USArray/researchers/adopt.html.



Real-Time Station Status

To view a map of current Transportable Array stations, visit http://www.earthscope.org and click on 'Current Status Map'.

To view seismograms recorded at a USArray station, go to http://usarray.seis.sc.edu/ and enter the station code.

Transportable Array Coordinating Office

usarray@iris.edu
1-800-504-0357

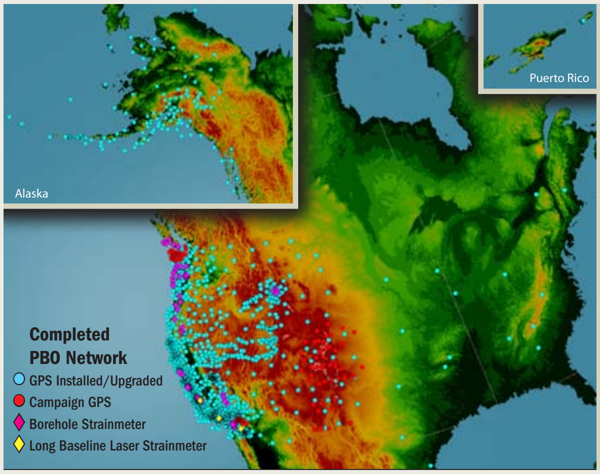
During the last few months, a new piece of hardware has been introduced into the station vaults. The field engineer is now placing the station's electronics and auxiliary equipment in a clear, airtight enclosure mounted on the vault wall. This interface box protects the instruments from moisture, standardizes connections, and improves component management to provide an overall increase in equipment reliability. ■

project status: PBO

Construction of the Plate Boundary Observatory (PBO), a network of 1,100 GPS stations designed to study the three-dimensional strain field resulting from active plate boundary deformation across the western United States, is now complete. The network currently operates at a 95% uptime, after transitioning through a tough winter in Alaska and high snows in the Rocky Mountains. The EarthScope community is using the network and data to support a variety of exciting and new science research.

Professors John Platt and Thorsten Becker of the University of Southern California are using PBO GPS data around the San Andreas Fault to create a theoretical model of the crustal deformation pattern from a large strike-slip fault system. Such models will provide a tool to predict and interpret the deformation around other strike-slip faults.

Paul Bodin, network manager of the Pacific Northwest Seismic Network (PNSN), notes that the PNSN currently uses PBO seismic data extensively in monitoring of Cascadia seismic and related volcanic hazards. The increased sensitivity of the deep borehole instrumentation adds unprecedented sensitivity to the regional seismic network. The PNSN particularly appreciates the low-noise view of the magmatic rumblings of Mount St. Helens and the growling of the newly discovered tremor of the subduction megathrust fault.



PBO Data Products

All PBO data products are immediately freely available and can be accessed at http://pboweb.unavco.org.

PBO Regional Offices

Alaska
907-346-1523

Pacific Northwest
509-933-3221

Basin and Range
801-466-4634

Northern California
510-215-8100

Southern California
951-779-6400

To learn more about PBO visit http://pboweb.unavco.org/. ■

project status: SAFOD

The San Andreas Fault Observatory at Depth (SAFOD) drilled a two-mile (3-km) long borehole across the active San Andreas fault zone in central California from 2004-2005, retrieving core samples that will help researchers study the origins of earthquakes. According to Dr. Stephen Hickman, a co-principal investigator of SAFOD, the first round of core samples has been distributed to researchers, and the evaluation of the second round of core sample requests is currently underway. Exciting results include the discovery of talc – a soft, slippery mineral that may allow the fault to creep aseismically – and the unique mineralogy, composition, and geochemical signature of the San Andreas fault zone. SAFOD results will be presented at the 2009 EarthScope National Meeting in Boise, Idaho. ■

EarthScope Scientists to Present New Discoveries

Every other year, several hundred scientists and educators from across the United States meet at the EarthScope National Meeting to share exciting discoveries made with data collected by EarthScope. This year's meeting will be held in Boise, Idaho, May 12-15 (www.earthscope.org/meetings/national_meeting_09).

During the meeting, two and a half days are dedicated to the presentation and discussion of scientific results. The sessions will focus on a wide breadth of topics including fault zone processes, deformation of the western US, and deep Earth structure. Field trips will take meeting participants to the Owyhee Mountains and the Boise hydrogeophysical research site. A post-meeting trip up the Snake River Plain to Yellowstone follows the plume trail to the current hotspot location and highlights the magmatic and tectonic history and current deformation of the region.

Several workshops are being offered this year to bring the excitement of cutting-edge EarthScope research to classrooms and general audiences. In one workshop, rangers from the National Park Service will introduce interpretive methods that can help scientists communicate EarthScope results to the public. A second workshop focuses on EarthScope materials for teachers to use in their classrooms.

EarthScope instruments provide enormous amounts of high-quality data that lead to discoveries, like detection of slow earthquakes along the San Andreas Fault

in California, and to greater understanding of complex concepts, like the illumination of intricate structures beneath the North American continent. Perhaps measurements from your station are key to exciting discoveries that will be presented at the upcoming EarthScope National Meeting! ■

featured science: Yellowstone National Park: The Recent Earthquake Swarm

(continued from front)

Data collected from new instruments deployed by EarthScope are aiding scientists from the University of Utah in interpreting the earthquake swarm. Earthquake Recording Station H17A was installed in the park in the fall of 2007 and is located on the western edge of Yellowstone Lake (see Figure 1). Other EarthScope instruments in the area include 24 Global Positioning Systems (GPS), five borehole strainmeters, six borehole seismometers, and six tiltmeters. These instruments augment a network of 28 seismographs that have been operated for many years by the University of Utah. Together these instruments enhance volcanic and seismic hazards monitoring, improve the determination of earthquake locations and the identification of anomalous sources of seismic activity, and provide additional clues to better understand how earthquakes originate.

Prior to this latest earthquake swarm, the last notable swarm in the Yellowstone region occurred in 2004. That year, GPS instruments measured the Yellowstone caldera uplifting at a rate of 2.7 inches (7 centimeters) per year, three times faster than the average rate during recorded history. Researchers attributed this deformation to the magmatic recharge of the Yellowstone magma chamber at a depth of 6 miles (10 km). Since then, the rate has decreased to about 1.5 inches (4 centimeters) per year.

Monitoring and studying this complex volcanic system continues. With access to new data from the EarthScope instruments coupled with measurements from the University of Utah stations in the Yellowstone region, researchers hope to better understand what is really happening below the surface. ■

By: Robert B. Smith, Jamie Farrell and Christine Puskas, Department of Geology and Geophysics, University of Utah.

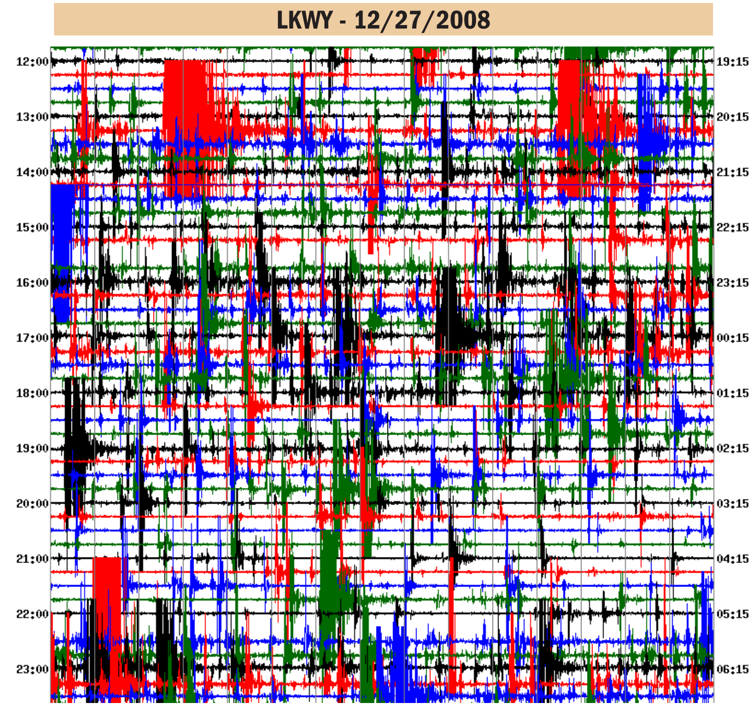


Figure 2. The earthquake swarm activity recorded at seismic station LKWY on December 27, 2008, from 12:00 pm (noon) to 23:30 pm (11:30 pm) Mountain Standard Time. This station was the closest to the earthquake swarm (see Figure 1) and is operated by the University of Utah Seismograph Stations. Located at Lake Junction in Yellowstone National Park, this seismic station is co-located with GPS station LKWY.

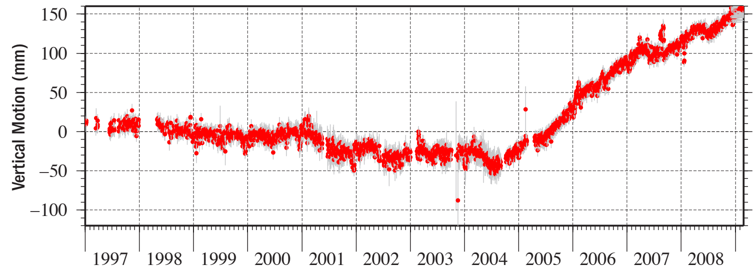


Figure 3. This plot shows the vertical motion of GPS station LKWY located at the north end of Yellowstone Lake. The area moved downward about 2 inches (5 centimeters) between 1997 and mid-2004. Since then, the data show that as of February 2009 the total uplift at LKWY has reached about 8 inches (20 centimeters).

View today's activity at University of Utah Seismic Station LKWY by visiting http://www.quake.utah.edu/helicorder/lkwy_webi.htm.

Look at seismograms recorded at EarthScope's Earthquake Recording Station in Yellowstone National Park with the USArray Station Monitor at http://usarray.seis.sc.edu/ and entering station code H17A.

Learn more about volcano monitoring at Yellowstone National Park by visiting the Yellowstone Volcano Observatory web site at http://volcanoes.usgs.gov/yvo/.

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Earthquake Recording Station W29A near Amarillo, Texas, became operational in January 2009.

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