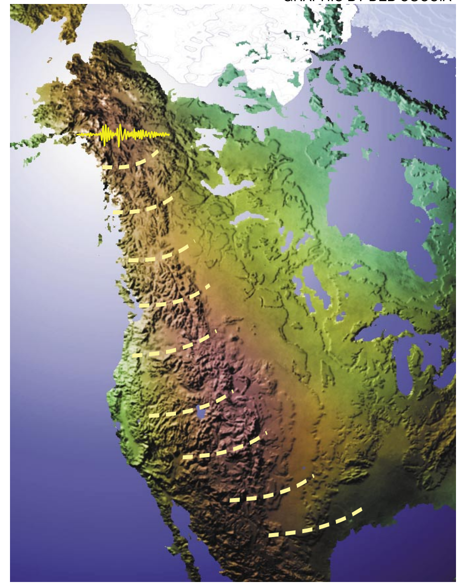
Earthquake Stirs Lower 48 Volcanoes, but Lulls Alaska Volcanoes to Sleep

After the Great Alaska Earthquake of 1964, the volcanic Mt. Wrangell heated up in response to the tremendous energy released by the magnitude 9.2 earthquake. It warmed up enough to melt 40 million cubic meters of ice from the crater in the 12 years following the earthquake, according to measurements by GI Professor Emeritus Carl Benson.

By contrast, Mt. Wrangell became less seismically active for five months following the Denali Fault earthquake. However, seismic activity increased briefly in Yellowstone, Long Valley Caldera, and other Lower 48 volcanic features, providing a mystery for volcanologists to unravel.

GRAPHIC BY DEB COCCIA



The Denali Fault earthquake that occurred in Alaska sent shock waves to other parts of the United States.

“Most Alaska volcanoes did little, while other places far away responded,” said John Sanchez of the Alaska Volcano Observatory (AVO).

Sanchez, a GI graduate student, presented the initial reactions of some of Alaska's volcanoes at the American Geophysical Union fall meeting in San Francisco. He also discussed the findings of his GI colleagues, Research Professor Steve McNutt and Research Technician Scott Stihler, as well as USGS seismologists Seth Moran and John Power, who work for AVO in Anchorage. “The paucity of triggering seismicity (in Alaska) is in striking contrast to triggered seismicity recorded at Yellowstone, Mammoth Mountain, The Geysers, Coso and Mount Rainier following the Denali Fault earthquake, all at much greater distances from the 7.9 earthquake than the Alaska volcanoes,” Moran wrote.

PHOTOS BY GUY TYTGAT

MONITOR—Senior Project Engineer Steve Estes installs and monitors seismic equipment on Mt. Wrangell.

Of the 24 volcanoes in Alaska that AVO monitors with seismic networks, those in the Katmai Volcanic Cluster at the head of the Valley of 10,000 Smokes were the only ones to show an increased number of earthquakes in the hours following the Denali Fault earthquake.

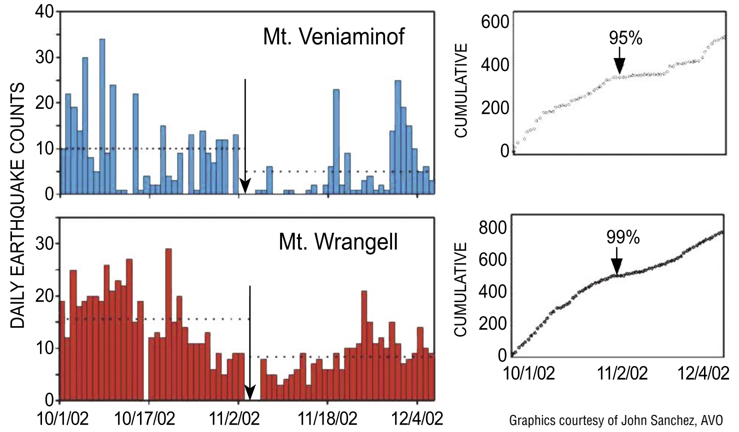
Other volcanoes, such as Mt. Veniaminof and Mt. Wrangell, showed decreased seismicity after the earthquake that lasted from one to several weeks.

“It's as if the earthquake shut off activity for awhile,” Sanchez said.

For at least 15 days following the Denali Fault earthquake, Mt. Wrangell, the closest volcano to the Denali Fault, had a seismicity rate that was 30 percent lower than before the earthquake. For two weeks after the earthquake, Mt. Veniaminof experienced a similar decrease.

“There has been some research that suggests a link between large earthquakes and volcanic activity,” Sanchez said. “In terms of changes of seismic activity, some of the faults that exist beneath a volcano could be brought closer to failure, or farther away from failure.”

Seismologists have discovered that energy from the Denali Fault earthquake traveled southeast in surface waves that expressed themselves in sloshing bodies of water as far south as Louisiana. However, the reactions of volcanoes far away from the epicenter—and the lack of activity within Alaska's volcanoes—remain a subject of research.



Seismicity rates from 33 days before to 33 days after the m 7.9 earthquake are shown for two Alaska volcanoes. A drop of nearly 50% in the daily number of earthquakes is observed at both volcanoes near the event. Displayed in the graph are discrete counts and cumulative sums and confidence levels at which the change of rate is estimated.

Earthquake Information Website Bombarded

Reaching out to a public hungry for news about the largest earthquake in 2002 was one of the duties the Alaska Earthquake Information Center needed to perform in the wake of the quake. AEIC's website was bombarded with information requests shortly after the Denali Fault earthquake occurred on November 3, 2002.

“We went from under 20,000 hits the day before the quake to nearly 480,000 hits on November 3 and 800,000 hits the day after,” said AEIC Senior System Analyst Mitch Robinson.

The website—www.giseis.alaska.edu— was modified to accommodate the extra traffic. By visiting the site, users can learn where and when earthquakes occur and report how earthquakes affect them. The site also offers information about earthquakes around the globe, and provides links to disaster-preparedness sites. For nine days after the 7.9 earthquake, the website got more than 100,000 hits each day. The website also logged 348,000 hits on October 23, 2002, the day of the earthquake's 6.7 foreshock.

PHOTO BY AKIHIKO ITO

ANALYZING DATA — Seismologists (from left) Kelly Kore, Doug Christensen, Martin LaFevers and Josh Stachnik work in the AEIC lab within the Geophysical Institute.

PHOTO BY JEFF PEDERSON

EARTHQUAKE RECORD—State Seismologist Roger Hansen points to a helicorder in the AEIC lab showing seismic activity as a result of the November 3, 2002, earthquake.

AEIC Alaska Earthquake Information Center
Geophysical Institute, UAF

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For GI Scientists, Denali Fault Earthquake Offers a Once-in-a-Lifetime Opportunity

Geophysical Institute seismologists had the rare chance to work on the largest earthquake in the world in 2002.

The Denali Fault earthquake of November 3, 2002, had a magnitude of 7.9. It shook Alaska from Anchorage to Fairbanks for more than two minutes and scarred 300 kilometers of Alaska's surface. Because the epicenter was in the Alaska Range far from population centers, the tremendous energy released by the earthquake killed no one, and injuries were limited to a broken arm suffered by a woman in Mentasta Pass, a village that experienced shaking.

“Working on this earthquake is a once-in-a-lifetime opportunity,” said GI Associate Professor Jeffrey Freymueller. “It's bigger than the 1906 earthquake in San Francisco.”

The location and magnitude of the Denali Fault earthquake and its aftershocks were determined by the Alaska Earthquake Information Center. AEIC, a GI lab under the direction of State Seismologist Roger Hansen, receives data from more than 370 seismic stations, and integrates seismic networks in Alaska. After the earthquake, geologists from around the globe traveled to Alaska to measure and photograph offset highways, deep scars on the snowless ground, and the trans-Alaska pipeline, still intact, but teetering on its supports in places.

Freymueller and fellow GI geodesists used GPS measurements to track movements along geologic faults. They also surveyed about 30 sites that provided information on motion before, during and after the earthquake. Following the earthquake, AEIC installed 26 seismic stations to complement their existing network. With the reinforced coverage around the Denali Fault, AEIC recorded more than 8,000 earthquakes in the first month after the 7.9 event.

PHOTO COURTESY OF ALASKA DOT

AEIC scientists shared data from their network of seismometers and GPS receivers at the American Geophysical Union meeting in San Francisco.

During a special AGU session about the earthquake, added to the schedule at the last minute, GI scientists presented 13 posters. Hansen, Freymueller, and USGS Geologist Peter Haeussler spoke to reporters from across the nation at a press conference held at the meeting.

GPS measurements along the Denali Fault made before the earthquake by GI Post-doctoral Fellow Hilary Fletcher have permitted scientists to determine exactly how rare an opportunity the Denali Fault earthquake presents for researchers.

Fletcher discovered the fault was slipping about 7 millimeters each year where it crosses the Richardson Highway and about 11 millimeters each year at its intersection with the Parks Highway. Based on the 8 meters of ground offset left by the earthquake in places, she determined that the strain had been building for about 1,000 years.

CRACKS—A resident of Mentasta Pass, a village that experienced intense shaking during the Denali Fault earthquake of November 3, 2002, inspects a crack that appeared near a local home (left).

PHOTO BY NED ROZELL

SCARS—The earthquake scarred more than 300 kilometers of Alaska's surface. This sudden crack formation appeared on the Canwell Glacier in the Alaska Range (left).

PHOTO BY STEVE ESTES

RESEARCH—GI Post-doctoral Fellow Hilary Fletcher uses a GPS unit (below).

UAF UNIVERSITY OF ALASKA FAIRBANKS

Denali Fault Earthquake Rocks GI Ford Excursion

AEIC Seismic Data Manager Josh Stachnik was driving a GI Ford Excursion on the Denali Highway the afternoon of November 3, 2002, when he and two other GI researchers felt the truck shaking.

"We were coming out of a minefield of potholes when I had noticed things had gotten awfully bumpy," Stachnik said. "I thought the left rear tire was gone."

Stachnik pulled over to let GI Research Technician John MacCormack and GI Research Assistant Kelly Kore out of the Suburban to check the tire. It was fine.

"The truck was stopped, but we were still bouncing around," Stachnik said. "That's when we knew," Kore said.

The three were 30 kilometers from the epicenter of the world's largest earthquake in 2002. They had been servicing seismometers AEIC had installed following the magnitude 6.7 Nenana Mountain earthquake of October 23, 2002, which has since become known as a foreshock to the Denali Fault earthquake.

"The truck kept rocking up and down and forward and back. It would've bounced away if I didn't have it in park," Stachnik said. "We were there for a good five minutes and the ground was moving the whole time, from the big event and a couple of good aftershocks."

Stachnik noticed trees moving back and forth, and heard swishing noises. "It wasn't a real windy day, but it sounded like it," he said. "We were in a lowland area with short bushes and spruce trees. I thought the sound came from the plants moving back and forth, rubbing against each other. It sounded sort of like a windy day in a hay field."

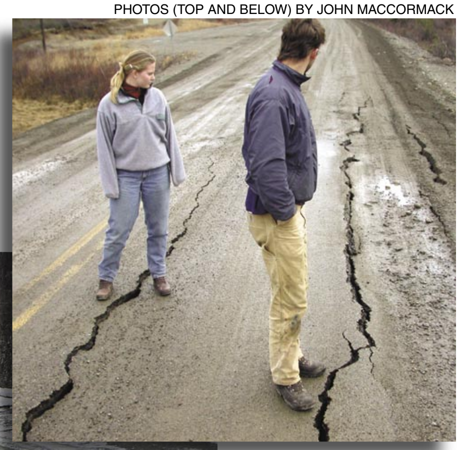
After the shaking stopped, Stachnik, Kore and MacCormack turned around and headed for Cantwell to report their experience.

The great earthquake was the start of several more weeks on the road. The three helped AEIC install a total of 26 new seismic stations along the Denali and Totschunda faults after the earthquake. Kore said she'll never forget standing near the epicenter of the Denali Fault earthquake.

"The time duration of the quake was long enough to really get a strong physical sense of how the earth was moving and of how powerful Mother Nature really is," Kore said. "I feel lucky to have been so close to the epicenter of such a large earthquake."

PHOTOS (ABOVE AND BELOW) COURTESY OF ALASKA DOT

PHOTOS (TOP AND BELOW) BY JOHN MACCORMACK

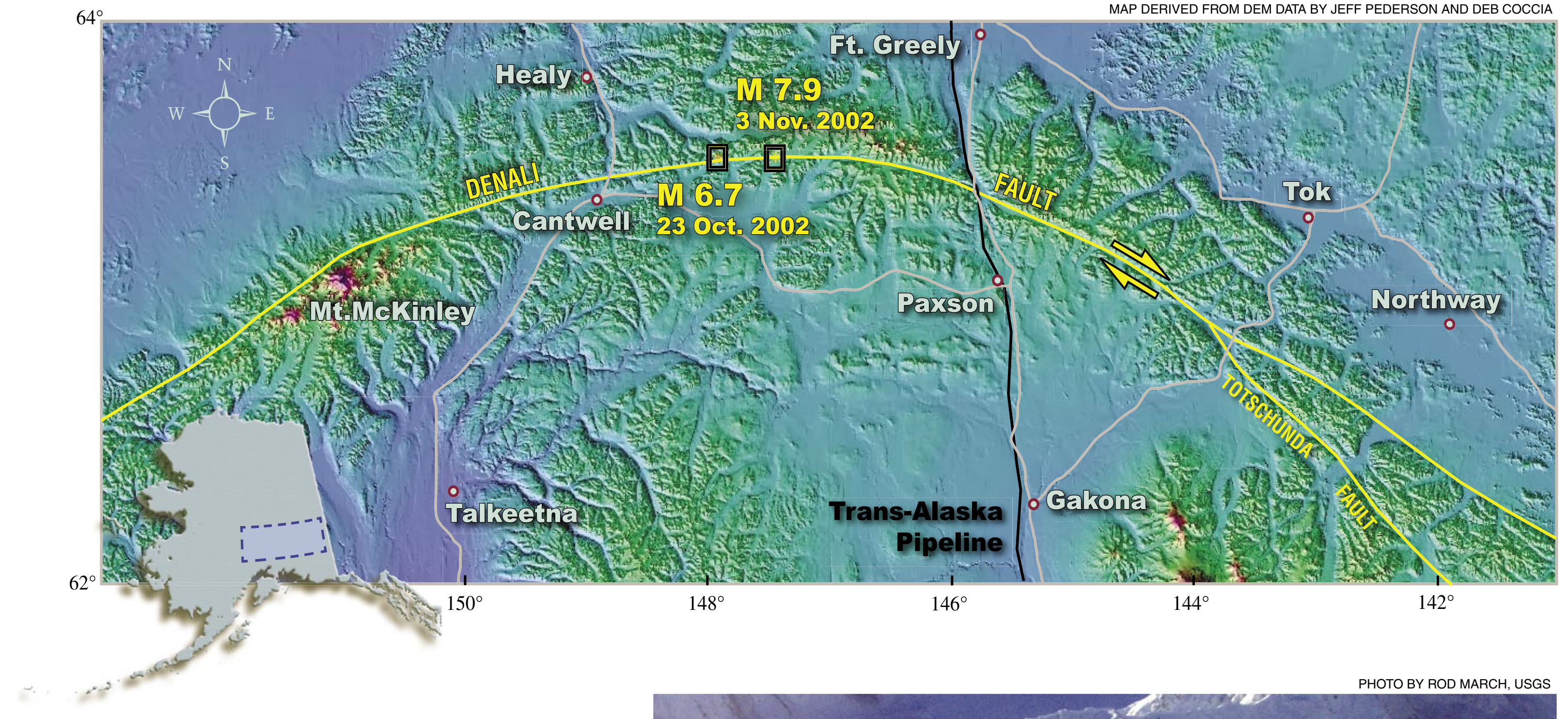


DAMAGE—Kelly Kore and Josh Stachnik stand on the Denali Highway to get a closer look at cracks in the road. Similar damage on the Tok Cutoff Road is shown in DOT photos (left). Kore and Stachnik were riding in the GI Suburban (top) when the earthquake occurred.

PHOTO BY GUY TYTGAT

SEISMIC—Kelly Kore installs seismic equipment at a GPS site along the George Parks Highway.

MAP DERIVED FROM DEM DATA BY JEFF PEDERSON AND DEB COCCIA



EARTHQUAKE EFFECTS — GI Research Technician Adam Bucki surveys the effect of the earthquake on Canwell Glacier.

PHOTO BY NED ROZELL

PHOTO BY ROD MARCH, USGS

AVALANCHE — The earthquake triggered a snow and rock avalanche on the upper Gakona Glacier (above) and three rock slides on Black Rapids Glacier (right). A fault trace is visible on the side of a ridge in the Gillett Pass and Lost Creek area (below).

PHOTO BY ROD MARCH, USGS

Alaska Range Glaciers Take a Hit

The Denali Fault looks like a long trench jutting through the middle of the Alaska Range on satellite images. Much of that trench is filled with glaciers, many of which have been changed forever by the earthquake on November 3, 2002.

Black Rapids Glacier will show the marks of the earthquake for centuries, according to GI Assistant Professor of Physics Martin Truffer.

Truffer flew over the Alaska Range with USGS glaciologists Dennis Trabant and Rod March three days after the earthquake.

High up on Black Rapids Glacier, they saw three large rockslides triggered by the earthquake. They estimated that rocks as large as helicopters now cover about 13 square kilometers of the glacier surface. Truffer has skied the length of the glacier before, a trip that would no longer be a pleasure.

"It would be a huge effort to get over the rock slides now, and it's going to get worse," Truffer said.

The new blanket of rocks covering an expansive section of Black Rapids Glacier will insulate the ice beneath it, Truffer said.

Ironically, the new rock slides cover the glacier in an area that loses more snow each year than it receives. Before the earthquake, the glacier lost about 4 meters of ice each year. Now it will lose much less. The rock coating will persist for hundreds of years as the glacier carries it like a conveyor belt toward the Delta River.

The earthquake triggered other rock, snow, and ice avalanches on the upper Gakona Glacier, and caused the collapse of huge ice towers on a tributary of the West Fork Glacier that was close to the earthquake's epicenter.

Adventurers were fortunate the earthquake struck in November rather than March, when mountaineers would have been climbing and skiing along the glaciers that fill the fault trench. Truffer, who was on Black Rapids last spring, said witnessing the rock avalanches on Black Rapids would have been a humbling experience.

"It would have looked like several mountains collapsing," he said. "If you were standing there witnessing it, you'd probably be so scared that you'd never go back to a mountain again."

PHOTO BY ROD MARCH, USGS

FAULT TRACE — The earthquake left a fault trace on the West Fork Chistochina Glacier, shown above.

DENNIS TRABANT AND ROD MARCH, USGS