The Day Denali Moved

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Earthquakes happen everyday-but not like this. One of the largest earthquakes recorded in American history occurred on the quiet Sunday afternoon of November 3, 2002 in a sparsely populated area about 80 miles south of Fairbanks, Alaska. Known as the Denali quake, the event measured 7.9 in magnitude (a size, scientists say, that could level a city like Los Angeles) and was felt as far away as Louisiana.
Due to the remote location, no one was killed, few were injured, and no major buildings or structures were lost. But scientists are still reeling from the event for a different reason. Shortly after the earthquake occurred in Alaska, many smaller events were clearly recorded throughout the western United States, leading scientists to ask the question: can one large earthquake trigger other earthquakes?

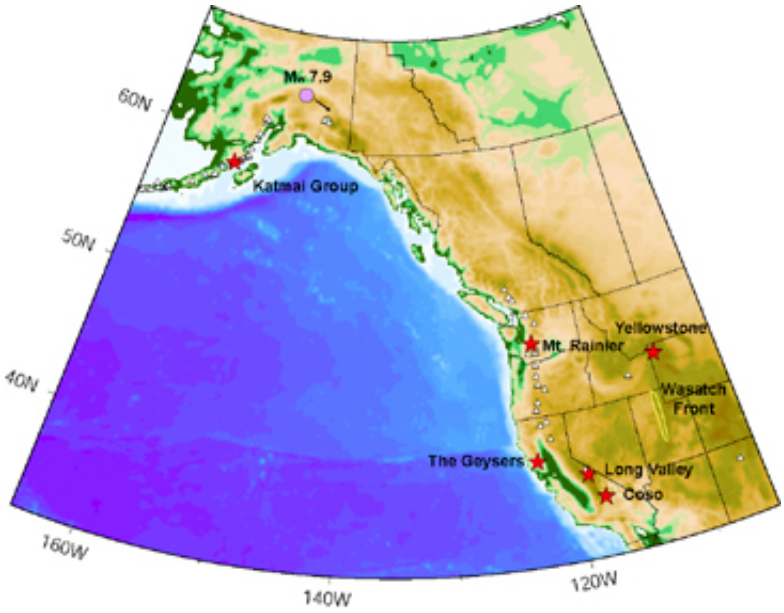


image courtesy of USGS
Locations of triggered events across the United States.

Earth scientists have long speculated that one earthquake could cause a chain reaction of other earthquakes, much like a line of falling dominos. But in the past there hasn't been much evidence to support or study this idea that earthquakes trigger one another. Now, information recorded during and after the Denali quake is filling that void and fueling one of the hottest research questions in earth science today.

Evidence and interpretations of the small earthquakes throughout the west following the Denali quake were presented at the annual meeting of the American Geophysical Union (AGU), held in San Francisco from December 6 thru 10. Researchers were careful to use the word "trigger," as no one knows why, how, or if the Denali quake caused the many small events that happened. But within hours after the quake in Alaska, an unusual number of local earthquakes were recorded in Washington, California, Wyoming and Utah-generating a pulse of excitement and research from the scientific community.

Stephanie Prejean, a scientist with the United States Geological Survey (USGS) in Menlo Park, California, presented data during a special session at the meeting on earthquakes that occurred in Washington and California 15 to 17 minutes after the Denali quake.

At Mount Rainier in central Washington, a series of small earthquakes measuring less than magnitude 2 occurred over a few minutes. At Geysers Geothermal Field in western California and Coso Geothermal Field in southeastern California, small quakes lasted for roughly 30 minutes.

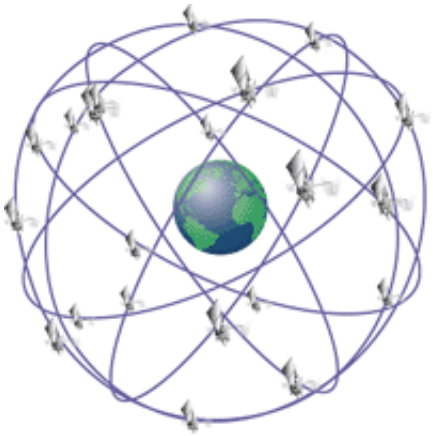
In Utah the number of small earthquakes increased significantly following the Denali event, according to Kristine Pankow of the University of Utah. This increase in seismicity included a magnitude 2.6 quake that occurred at the same time the rolling energy from the Denali quake hit Utah, leading scientists to speculate that the Alaska earthquake triggered the events.

Nearby in Yellowstone National Park in Wyoming, more than 200 small earthquakes were recorded in the 17 hours following the Denali quake, the largest measuring magnitude 2.5. Small earthquakes in Yellowstone are not uncommon in focused locations, but this series of events was unusual because it spread throughout the park and was not restricted to one spot.

The rumbles following Denali are relatively simple for scientists to record and analyze, and they represent just one of the ways in which the earth is immediately effected by a large quake. Other, more long-term affects of an earthquake can take years to happen and even longer for scientists to study.

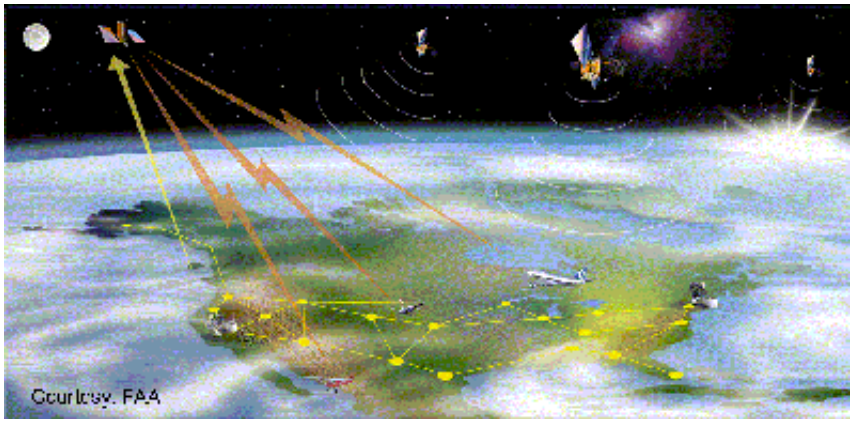
One such effect is the stretching or moving of the surface of the earth caused by an earthquake. In its simplest form, this can be the distance a piece of Earth moves during or after an earthquake.

The earthquake in Alaska happened along the Denali Fault, a place where one piece of the earth slipped quickly alongside another piece. The movement of rock on the surface caused by this slip is most clearly seen in the area nearest the earthquake. Farther away from the earthquake, the ground movement takes longer to happen (as rocks tend to move very slowly) and is smaller, which makes it more difficult to measure. Scientists will be studying the ground movements from the Denali quake in the decades to come using Global Positioning System (GPS) instruments.



24 GPS satellites in orbit

GPS consists of receivers anchored in the ground that use signals from satellites circling the globe to determine a location very precisely. The satellite signal contains a time stamp. When the signal reaches the GPS instrument in the ground another time stamp is gathered. The difference in the times is used to calculate the distance between the satellite and GPS receiver in the ground. When the ground moves, the movement is recorded as a change in distance between the satellite and GPS instrument. At the AGU meeting, Prejean presented evidence of very small movements measured in the Long Valley Caldera in California after Denali. There are likely more to come, but scientists need time and better instrumentation to measure such changes.



GPS satellites can interact with a variety of instruments at many locations

If funded by Congress, EarthScope's Plate Boundary Observatory (PBO) will give scientists the tools to measure earth's movements more precisely. PBO will include a network of GPS receivers placed every 100 km from the west coast to the Rocky Mountains in the lower 48 states and all across Alaska. Scientists will also install dense groupings of GPS receivers in special areas of interest such as the San Andreas Fault in California.

These extra instruments provided by EarthScope will help scientists better measure and study movements caused by earthquakes, volcanoes and other tectonic forces. By understanding these movements, researchers hope that one day we will better understand how one earthquake may trigger another. Fortunately no major damage was caused by the Denali quake in Alaska or further away, but that may not be the case the next time around.

More information

USGS Denali Earthquake Information

National Park Service
Alaska Volcano Observatory

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