Great Indian Ocean earthquake of 2004 set off tremors in San Andreas fault

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In the last few years there has been a growing number of documented cases in which large earthquakes set off unfelt tremors in earthquake faults hundreds, sometimes even thousands, of miles away.

New research shows that the great Indian Ocean earthquake that struck off the Indonesian island of Sumatra on the day after Christmas in 2004 set off such tremors nearly 9,000 miles away in the San Andreas fault at Parkfield, Calif.

"We found that an earthquake that happened halfway around the world could trigger a seismic signal in the San Andreas fault. It is a low-stress event and a new kind of seismic phenomenon," said Abhijit Ghosh, a University of Washington doctoral student in Earth and space sciences.

"Previous research has shown that this phenomenon, called non-volcanic tremor, was produced in the San Andreas fault in 2002 by the Denali earthquake in Alaska, but seeing this new evidence of tremor triggered by an event as distant as the Sumatra earthquake is really exciting," he said.

Ghosh is to present the findings next week (Dec. 17) in a poster at the American Geophysical Union annual meeting in San Francisco.

The Indian Ocean earthquake on Dec. 26, 2004, was measured at magnitude 9.2 and generated tsunami waves that killed a quarter-million people. It was not known, however, that an earthquake of even that

magnitude could set off non-volcanic tremor so far away.

The San Andreas fault in the Parkfield region is one of the most studied seismic areas in the world. It experiences an earthquake of magnitude 6.0 on an average of every 22 years, so a variety of instruments have been deployed to record the seismic activity.

In this case, the scientists examined data from instruments placed in holes bored in the ground as part of the High-Resolution Seismic Network operated by the University of California, Berkeley, as well as information gathered by the Northern California Seismic Network operated by the U.S. Geological Survey.

Signals corresponding with non-volcanic tremor at precisely the time that seismic waves from the Indian Ocean earthquake were passing the Parkfield area were recorded on a number of instruments as far as 125 miles apart.

"It's fairly obvious. There's no question of this tremor being triggered by the seismic waves from Sumatra," Ghosh said.

Scientists have pondered whether non-volcanic tremor is related to actual slippage within an earthquake fault or is caused by the flow of fluids below the Earth's surface. Recent research supports the idea that tremor is caused by fault slippage.

"If the fault is slipping from tremor in one place, it means stress is building up elsewhere on the fault, and that could bring the other area a little closer to a big earthquake," Ghosh said.

Monitoring tremor could help to estimate how much stress has built up within a particular fault.

"If the fault is closer to failure, then even a small amount of added stress likely can produce tremor," he said. "If the fault is already at low stress, then even high-energy waves probably won't produce tremor."

The work adds to the understanding of non-volcanic tremor and what role it might play in releasing or shifting stress within an earthquake-producing fault.

"Our single-biggest finding is that very small stress can trigger tremor," Ghosh said. "Finding tremor can help to track evolution of stress in the fault over space and time, and therefore could have significant implications in seismic hazard analysis."

Source: University of Washington

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