Slowly Slip-Sliding Faults Don't Cause Earthquakes

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This is an antenna for receiving GPS signals in a geodesy network located in northern Italy. Credit: Copyright 2006 Sigrun Hreinsdottir

(PhysOrg.com) -- Some slow-moving faults may help protect some regions of Italy and other parts of the world against destructive earthquakes, suggests new research from The University of Arizona in Tucson.

Until now, geologists thought when the crack between two pieces of the Earth's crust was at a very gentle slope, there was no movement along that particular fault line.

"This study is the first to show that low-angle normal faults are definitely active," said Sigrún Hreinsdóttir, UA geosciences research associate.

Richard A. Bennett, a UA assistant professor of geosciences, wrote in an e-mail. "We can show that the Alto Tiberina fault beneath Perugia is steadily slipping as we speak--fortunately, for Perugia, without producing large earthquakes."

Perugia is the capital city of Italy's Umbria region.

Creeping slowly is unusual, Bennett said. Most faults stick, causing strain to build up, and then become unstuck with a big jerk. Big jerks are big earthquakes.

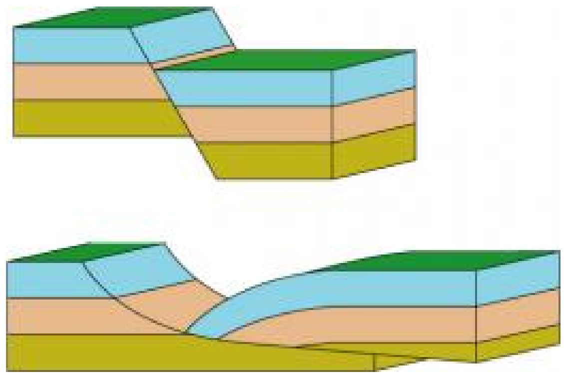
For decades, researchers have known about the Alto Tiberina and similar faults and debated whether such features in the Earth's crust were faults at all, because they didn't seem to produce earthquakes.

Hreinsdóttir and Bennett have now shown that the gently sloping fault beneath Perugia is moving steadily at the rate of approximately one-tenth of an inch (2.4 mm) a year.

Perugia has not experienced a damaging earthquake in about 2,000 years, Hreinsdóttir said. Because the fault is actively slipping, it might not be collecting strain, she said. "To have an earthquake, you have to have strain."

Other towns in the region that lie near steeply sloping faults, including L'Aquila and Assisi, have experienced large earthquakes within the last 20 years.

The team published their paper, "Active aseismic creep on the Alto Tiberina low-angle normal fault, Italy," in the August issue of Geology. The National Science Foundation funded the research.



The graphic on the top shows how a high-angle normal fault cuts between two of the earth's plates. The block on the right shifts down as the fault moves. The graphic on the bottom shows a low-angle normal fault. The block on the right cannot move directly down, but instead can slip to the right. (Credit: Gabriele Casale)

In the same issue of *Geology*, Geoffrey A. Abers terms the UA team's work "a fascinating new discovery." Abers, of Lamont-Doherty Earth Observatory of Columbia University in Palisades, N.Y., was not involved in the research.

The UA team became interested in the Alto Tiberina fault because previous research suggested the fault might be moving.

To check on the fault, the UA team measured rock movements in and around Perugia using a technique called geodesy.

Geodesy works much like the GPS system in a car. Geoscientists put GPS units on rocks, Bennett said. Just as the car's GPS uses global positioning satellites to tell where the car is relative to a desired destination, the geodesy network can tell where one antenna and its rock are relative to another antenna.

Taking repeated measurements over time shows whether the rocks moved relative to one another.

In some cases, the GPS sites are too far apart to attribute very small movements of the Earth to an individual fault such as the Alto Tiberina, Hreinsdóttir said. However, the University of Perugia established a dense network of GPS stations in the region in 2005.

The UA team analyzed data from 19 GPS stations within approximately a 30-mile (50 km) radius around Perugia. Having such closely spaced stations and several years of data were key for detecting the fault's tiny motions, she said.

"This study is one more piece in the puzzle to understand seismic hazards in the region and can apply to other regions of the world that have low-angle normal faults," Hreinsdóttir said.

Bennett said there are numerous examples of such faults that are thought to be inactive, including the western U.S., Italy, Greece and Tibet.

He and UA geosciences doctoral candidate Austin Holland are now investigating similar faults in Arizona. One such fault, the Catalina Detachment, was involved in the formation of the Santa Catalina and Rincon Mountains that surround Tucson to the north and the east.

"No large earthquakes are known to have occurred on the Catalina detachment in historic times, so we don't really know if that fault is active or not," Bennett said. "Based on the results from the Alto Tiberina, it's possible the Catalina Detachment fault just slides very slowly and doesn't produce earthquakes."

The motion would be so slow as to be undetectable until the most recent technological advances in geodesy, he said. "The technology has evolved so far that we are now confident we can see little motions."

To better assess the earthquake risk in the Tucson region, his team is using geodesy throughout southern Arizona to recheck the markers that the National Geodetic Survey measured in the late 1990s.

"Now we can go out and repeat measurements to see how the positions have changed in ten years," he said.

Bennett will soon be able to say how fast the Tucson area's mountains are moving -- his team took measurements earlier this year and is analyzing the data now.

Source: University of Arizona (news : web)