Water flow tracks earthquake healing

Rock permeability in the fault that unleashed China's 2008 quake shows that fractures mend quicker than was thought.

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Drilling into the fault that caused China's devastating 2008 earthquake may give clues to how fractures mend themselves.

Instruments buried half a kilometre beneath the Chinese countryside show just how quickly a geological fault heals after a major earthquake. The work may be the best glimpse yet at how rock recovers in a fault zone.

In the years after the devastating 2008 Sichuan quake, which killed at least 70,000 people, researchers studied the rate at which groundwater seeped into a borehole at the fault as a measure of its healing process. Fracturing during a violent earthquake increases rocks' permeability to water, but this decreases again as the rock heals.

The team found that the rate of water flowing into the hole slowed rapidly during an 18-month observation period starting about two years after the quake. This indicated that tiny fractures in the rock might have been shrinking, constricting the water flow and essentially healing the fault.

The work also suggests that this particular fault healed faster than expected. The study is published in *Science*[1].

“I’m really excited about these kinds of results because they give us clear observations about what is happening at depth in fault zones,” says Jean Elkhoury, a geoscientist at the University of California, Irvine, who was not involved in the work.

Every so often, the water flow in the drill hole sped up again as nearby earthquakes sent seismic waves racing through the ground, shaking the rock and interrupting the healing process.

“This is a more complex interplay between damage and healing than maybe we had anticipated,” says Emily Brodsky, an earthquake physicist at the University of California, Santa Cruz, and a member of the research team.

Drilling deep

Months after the magnitude-7.9 quake hit, researchers drilled four holes into the fault responsible, planning to study temperature changes. But in a lucky break, says Brodsky, the instrument strings happened to carry pressure sensors as well.

Those sensors showed that permeability, or water flow in the rock, dropped quickly between January 2010 and June 2011, says Lian Xue, an earthquake physicist at the University of California, Santa Cruz, who led the work. That was faster than had been predicted in earlier modelling studies, suggesting that the models might have to be adjusted.

The observations are just one glimpse at one particular location, points out François Renard, a geoscientist at Joseph Fourier University in Grenoble, France. Healing of other fault zones might be affected by other factors, he says — such as the presence of clays or other minerals that help to seal fractures. That could make it hard to extrapolate findings from the Chinese fault to other parts of the world.

The latest study is part of a wider push to drill into earthquake zones soon after they rupture. In 2012, ocean drillers penetrated the sea floor off Japan to lower temperature sensors into the fault that unleashed the 2011 killer Tohoku quake. A second team retrieved the instruments in April this year, and Brodsky and others are probing the data for clues to how the frictional heat of the rupture dissipated over time, which could provide information about the behaviour of the sea floor during the quake.

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References

1. Xue, L. *et al*. *Science* **340**, 1555–1559 (2013).