Study offers explanation for earthquakes setting off distant quakes

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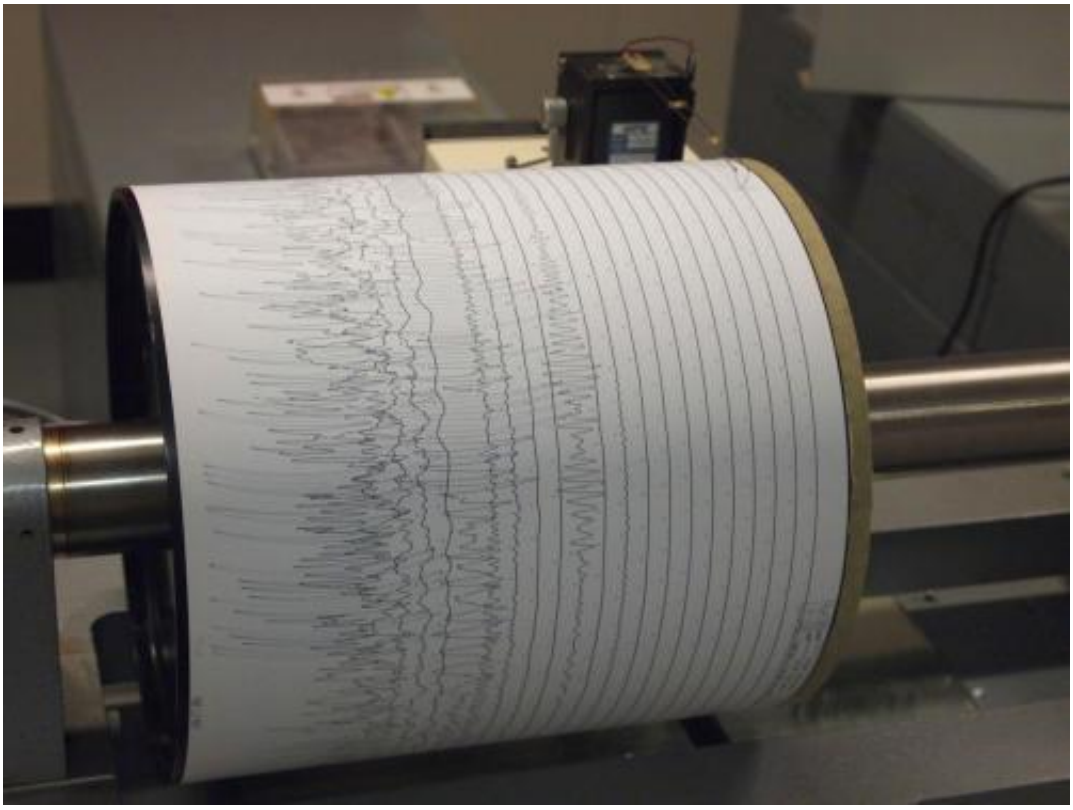

Seismogram being recorded by a seismograph at the Weston Observatory in Massachusetts, USA. Credit: Wikipedia

(Phys.org)—A team of researchers with Second University of Naples has developed a model that may help explain how it is that some earthquakes set off other earthquakes up to a thousand miles away. In their paper published in *Physical Review Letters,* the team describes how

they constructed a physical model, watched how it behaved under stress and then came up with their theory.

Earthquakes, as most everyone knows, happen when compressed rock slides against other rock along a fault line—but what researchers have struggled to understand is how or why some earthquakes seem to cause other earthquakes to occur, that are too far away to be chalked up to mere ground vibrations.

To better understand what happens, the researchers set up some rocks in their laboratory, with some round granules between them—then applied pressure. As the rocks finally slipped, mimicking a real earthquake, the team recorded what happened with the grains between them. They found that they emitted acoustic waves. Next, they tried a similar experiment, but this time, broadcast a variety of acoustic waves in the vicinity of the grains—doing so revealed that for certain frequencies, the acoustic waves caused what the team describes as "lathering" where fluid-like motion occurred resulting in a sudden reduction in friction, causing the rocks on either side to slide against one another earlier than they would have otherwise. And that, the researchers suggest, might be what happens when one earthquake sets off another a long distance away—the sound waves created by one earthquake travel long distances to another site, cause the grains in a fault line they encounter to lather, and that is what sets off another earthquake. The lathering occurs, the researchers suggest, due to waves bouncing back and forth inside a fault.

The results beg the question: Why don't all earthquakes set off lots of other earthquakes in distant places? The answer, the team notes lies in the frequency of the acoustics waves—lathering only occurs for any given fault line within a certain narrow frequency range, and the impact they have will depend on the state of other fault lines—they have to be near ready to slip on their own.

The idea put forth by the team should not be too difficult to study in real situations, as acoustic recordings that occur in the vicinity of earthquakes could be compared with those captured at distant sites that have what appear to be, related seismic events.

More information: Dynamic Weakening by Acoustic Fluidization during Stick-Slip Motion, Phys. Rev. Lett. 115, 128001 – Published 15 September 2015. dx.doi.org/10.1103/PhysRevLett.115.128001

ABSTRACT
The unexpected weakness of some faults has been attributed to the emergence of acoustic waves that promote failure by reducing the confining pressure through a mechanism known as acoustic fluidization, also proposed to explain earthquake remote triggering. Here we validate this mechanism via the numerical investigation of a granular fault model system. We find that the stick-slip dynamics is affected only by perturbations applied at a characteristic frequency corresponding to oscillations normal to the fault, leading to gradual dynamical weakening as failure is approaching. Acoustic waves at the same frequency spontaneously emerge at the onset of failure in the absence of perturbations, supporting the relevance of acoustic fluidization in earthquake triggering.