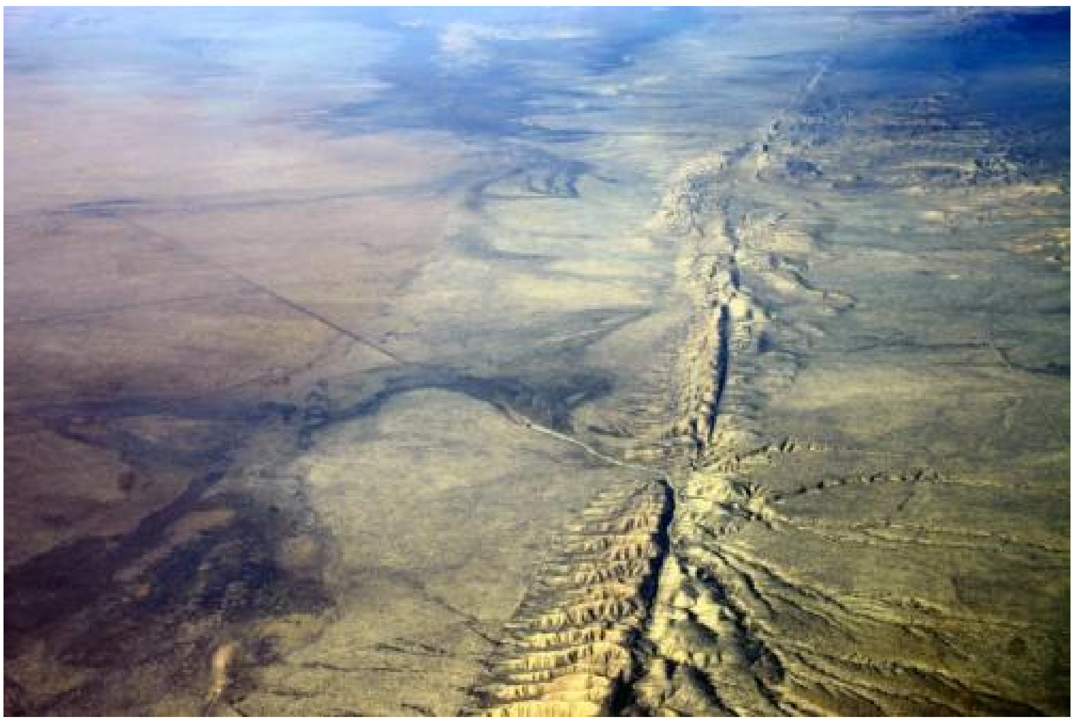
Researchers replicate supershear earthquakes in the lab

June 7 2013, by Bob Yirka



Aerial photo of the San Andreas Fault in the Carrizo Plain, northwest of Los Angeles. Credit: Wikipedia.

(Phys.org) —A team of geology researchers working in France has for the first time recreated the conditions in a lab that lead to a phenomenon known as a supershear earthquake. In their paper published in the journal *Science*, the researchers describe how they found that compressing granite under certain conditions caused ruptures to propagate faster than shear waves leading to an observable supershear event.

In a "normal" earthquake, seismic waves are generated as a result of faults in the Earth's crust that rupture. At the same time, deep within the Earth, shear waves are generated that also propagate but are not felt on the surface. Shear waves tend to move much faster than seismic waves. Sometimes, though, in very rare instances, seismic waves gain a boost in speed and wind up propagating faster than sheer waves. The result is what geologists call a sonic-boom type of earthquake that can be far worse than its magnitude would indicate. Supershear earthquakes have been recorded occurring in nature just a few times, but until now have never been reproduced in the lab.

To recreate the special conditions that lead to a supershear earthquake, the researchers subjected slabs of granite to very high pressure—pushing them together while also applying sideways pressure until they slipped against one another—releasing a wave of energy. It's the same type of experiment used to study various types of earthquake conditions. In this instance, the researchers replicated the experiment 200 times—each time taking careful measurements with acoustic sensors. The team found that by manipulating the pressure exerted they could induce supershear like conditions. Their experiment was the first ever to succeed in recreating a supershear earthquake-like event in the lab. More importantly, it also shows that supershear earthquakes can occur at a much smaller level than researchers had believed. This means, they say, that such earthquakes should be able to occur much more often in the real world.

The results obtained by the researchers aren't a sign that people should worry, however, because it's quite possible that the conditions in the lab were optimal for the creation of supershear earthquakes, most specifically the presence of smooth even granite surfaces—this is generally not the case in nature, and likely why they occur so seldom in the real world. The researchers suggest it's possible that many supershear earthquakes happen in nature, but we don't know about them because they occur in sections of faults that don't move.

More information: From Sub-Rayleigh to Supershear Ruptures During Stick-Slip Experiments on Crustal Rocks, *Science* 7 June 2013: Vol. 340 no. 6137 pp. 1208-1211 DOI: 10.1126/science.1235637

ABSTRACT
Supershear earthquake ruptures propagate faster than the shear wave velocity. Although there is evidence that this occurs in nature, it has not been experimentally demonstrated with the use of crustal rocks. We performed stick-slip experiments with Westerly granite under controlled upper-crustal stress conditions. Supershear ruptures systematically occur when the normal stress exceeds 43 megapascals (MPa) with resulting stress drops on the order of 3 to 25 MPa, comparable to the stress drops inferred by seismology for crustal earthquakes. In our experiments, the sub-Rayleigh–to–supershear transition length is a few centimeters at most, suggesting that the rupture of asperities along a fault may propagate locally at supershear velocities. In turn, these sudden accelerations and decelerations could play an important role in the generation of high-frequency radiation and the overall rupture-energy budget.

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