Seismic data suggests slow slip events may presage larger earthquakes

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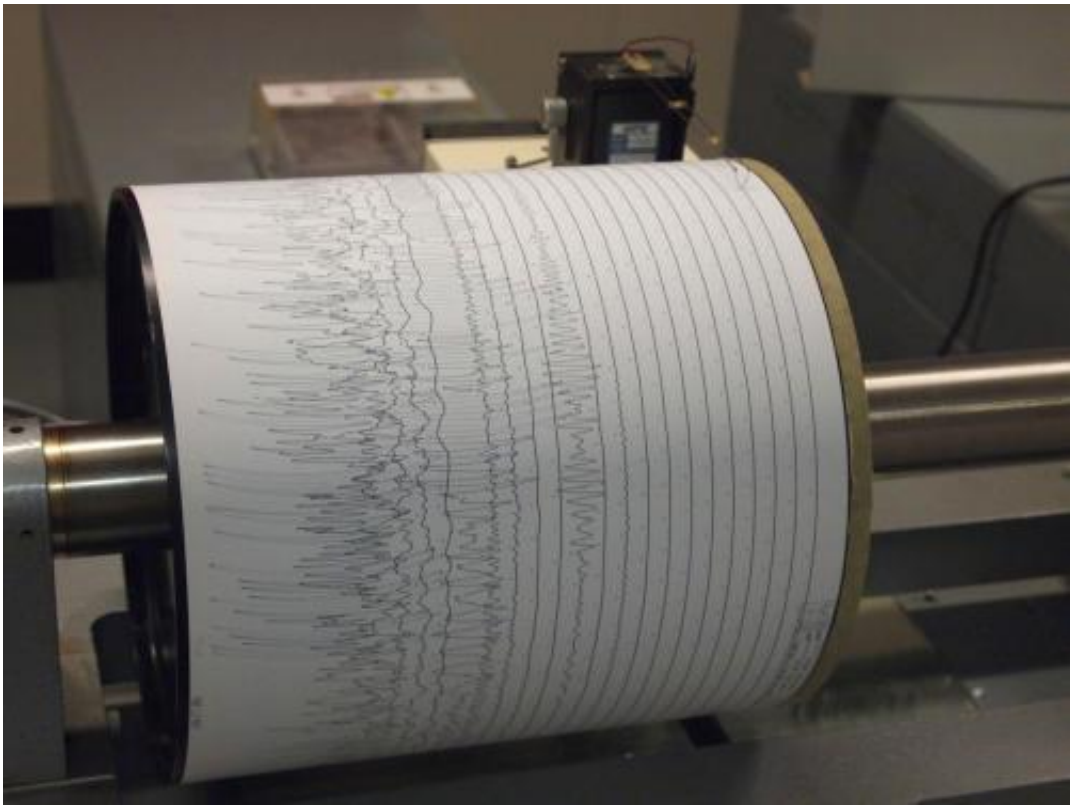

Seismogram being recorded by a seismograph at the Weston Observatory in Massachusetts, USA. Credit: Wikipedia

(Phys.org)—A team of researchers, two from Tohoku University in Japan and two from the University of California in the U.S., has found evidence that suggests that a speedup in small underground deformations may occur prior to larger earthquakes, possibly providing a means for

sounding a warning. In their paper published in the journal *Science*, the team describes how they pored over seismic data that spanned 28 years and which included approximately 6,000 seismic events, and what they found as a result—they also suggest that their findings might one day lead to a true earthquake early warning system.

Scientists the world over have for years been searching for a way to predict when an earthquake will strike, with enough certainty to warn people in the area. To date such efforts have come up empty, though much has been learned in the process. In this new effort, the researchers report that they believe they may have found a possible indicator of an impending quake, and it is based on what are known as slips, small underground movement similar to earthquakes, but which happen so slowly that they don't cause damage or even register on seismic monitors—the only way to detect them is to use GPS equipment.

To come to these conclusions, the researchers analyzed seismic data for Japan's two largest islands, going back to 1984. Doing so led to the identification of 1,500 instances where there appeared to be a pattern of repetition—that allowed them to estimate the speed at which the tectonic plates below were moving. They then used statistics to correlate slippages with non-repeating measurable quakes with a magnitude of 5 or higher. Doing so revealed that there appeared to be a speedup in slippage just prior to major earthquakes. The team also looked at GPS data, which can actually be used to measure tectonic shifting, and report that it matched the rates they had calculated earlier.

The team acknowledges that much more work needs to be done before it can be confirmed that GPS monitoring devices could one day offer an early warning system, but suggest their research shows that there is the potential for such an outcome.

More information: N. Uchida et al. Periodic slow slip triggers

megathrust zone earthquakes in northeastern Japan, *Science* (2016). DOI: 10.1126/science.aad3108

Abstract

Both aseismic and seismic slip accommodate relative motion across partially coupled plate-boundary faults. In northeastern Japan, aseismic slip occurs in the form of decelerating afterslip after large interplate earthquakes and as relatively steady slip on uncoupled areas of the subduction thrust. Here we report on a previously unrecognized quasi-periodic slow-slip behavior that is widespread in the megathrust zone. The repeat intervals of the slow slip range from 1 to 6 years and often coincide with or precede clusters of large [magnitude (M) ≥ 5] earthquakes, including the 2011 M 9 Tohoku-oki earthquake. These results suggest that inherently periodic slow-slip events result in periodic stress perturbations and modulate the occurrence time of larger earthquakes. The periodicity in the slow-slip rate has the potential to help refine time-dependent earthquake forecasts.