

Some deep-sea earthquakes send out early-warning signals, seismologists say

March 23 2005

Research published in Nature shows theoretical feasibility of quake forecasting

Earthquakes along a set of fault lines in the Pacific Ocean emit small "foreshocks" that can be used to forecast the main tremor, according to research in the March 24 issue of *Nature*.

It is the first demonstration that some types of large imminent earthquakes may be systematically predictable on time scales of hours or less.

Statistically reliable forecasting of imminent quakes has been an elusive goal for seismologists.

Co-author Thomas Jordan, director of the Southern California Earthquake Center in the USC College of Letters, Arts and Sciences, stresses that quakes on land generally do not show many foreshocks and cannot be predicted with the methods outlined in the *Nature* paper.

The research team, led by Jeffrey McGuire of the Woods Hole Oceanographic Institution, studied past earthquakes along two so-called transform faults on the East Pacific Rise, where tectonic plates are spreading apart. Sensor data from the National Oceanic and Atmospheric Administration pinpointed the time and location of foreshocks and earthquakes.

For the purposes of the study, the researchers defined a foreshock as any tremor of at least 2.5 magnitude on the Richter scale. Earthquakes were

tremors of no less than 5.4 magnitude.

The researchers then declared a hypothetical "alarm" for an hour within a 15-kilometer radius of the epicenter of every foreshock.

This retroactive and "naïve" early-warning system would have predicted six of the nine major earthquakes that occurred along the two faults between 1996 and 2001, researchers said.

The finding suggests that short-term prediction – the ability to forecast an earthquake in the hours or minutes before it hits – may be feasible under certain circumstances.

"This is the first demonstration of good short-term predictability for big earthquakes," Jordan said. "Some scientists believe that earthquakes come on suddenly with no warning signs, and the big ones are therefore unpredictable. In other parts of the oceans, they may be."

While any random guesser could have predicted six out of nine earthquakes by declaring enough alarms, the researchers' system performed between 300 and 1,000 times better, Jordan said.

And though the false-alarm rate was high, all false alarms taken together occupied only 0.15 percent of the total volume of space and time studied. The researchers believe they can improve both the accuracy and the lead-time of their forecasts. They hypothesize that both foreshocks and main tremors are caused by an earlier trigger event – possibly a slow, smooth sliding along the fault line that fails to generate seismic waves.

Such an event – called an aseismic slow slip transient – may be detectable with the proper instruments, said Jordan, who points out that movement along the San Andreas fault is recorded by an extensive array of sensors.

"If you could do the same thing on the sea floor then you would probably see this thing coming," he said.

Next year an oceanographic expedition led by McGuire will drop sensors along the East Pacific Rise to begin testing the researchers' hypothesis.

The possibility that slow slip transients may herald earthquakes has wider significance, researchers said. Slow slip transients have been detected in subduction zones, where one tectonic plate scrapes under another. The most powerful and dangerous earthquakes occur in subduction zones.

"The possibility that aseismic slip triggers large earthquakes on subduction megathrusts is especially intriguing given the observation that a slow slip transient occurred 15 minutes before the great 1960 Chilean megathrust earthquake," the authors wrote in Nature.

"Notably, subduction zones are observed to have higher foreshock rates than continental regions."

Still, Jordan said, the question of whether earthquakes on subduction zones are predictable systematically remains open and will require better observations.

Source: University of Southern California

Citation: Some deep-sea earthquakes send out early-warning signals, seismologists say (2005, March 23) retrieved 25 April 2024 from <https://phys.org/news/2005-03-deep-sea-earthquakes-early-warning-seismologists.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private

study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.