

Caltech scientists study quake speeds

By Kimm Groshong , Staff Writer
Thursday, March 18, 2004

PASADENA -- How would you go about studying the speeds at which earthquakes travel? Since we cannot predict when and where an earthquake will occur, the problem becomes difficult.

But three Caltech scientists have used an experiment in the laboratory to side-step Mother Nature. Their results, which appear in the current edition of the journal Science, provide the first solid evidence that spontaneously generated ruptures can reach the high speed seismologists call "supershear" --around 14,000 feet a second.

"This experiment has a lot of intellectual interest," said Hiroo Kanamori , a professor of geophysics and one of the study's authors.

For 25 years, scientists have suggested ruptures could reach supershear speeds. However, "not many people believed it, including myself," Kanamori said.

Theoretically, based on computer-simulated studies, the supershear speeds should have been possible, Kanamori said. "It turns out, under certain conditions, this can actually happen," Kanamori said.

Kanamori and his colleagues, Kaiwen Xia , a graduate student in geophysics, and Ares Rosakis , a professor of mechanical engineering, created a rupture by applying a strong current to a wire placed in a hole between two pieces of a special polymer. The resulting pressure promoted the type of sliding characteristic of an earthquake at a strike-slip fault such as the San Andreas.

They found that for the rupture to reach supershear speeds, it must travel a long distance, around 100 kilometers. Then it can transition to the faster supershear speed.

When a strong earthquake such as the 2003 event in Iran occurs, often a large, pulse-like motion, referred to as a "killer pulse," moves the ground. "This is the single important ground motion, I think, which has implications for structures," Kanamori said. The base of a high rise sitting on the ground affected by a killer pulse, for example, shifts sideways as the earth moves and then returns to its original location, often ruining the building.

But the intensity of the killer pulse is decreased when the rupture propagates at supershear speeds, Kanamori said.

"My guess is that (supershear) actually might make things better," said Thomas Heaton , a professor of engineering seismology who was not part of the study. However, he said, "it's a little early to tell." For example, during the Denali earthquake in 2002, "even though it seems that it probably was going supershear, it was still a very violent ground motion."

The supershear ruptures also produce shock waves much like the Mach cones associated with sonic booms that supersonic jets make. And scientists do not know precisely what effect those shock waves have on ground structures, Kanamori said.

"I think for the next few years, people will be debating this," Kanamori said.