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New UCSB Earthquake Study Improves Model, Shows Hazard to Structures Located Near the Fault

Thanks to recent advances in parallel computing, an interdisciplinary team of scientists at the University of California, Santa Barbara has discovered a peculiar and important aspect of how seismic waves are generated during an earthquake. The results are published in the March 7 edition of Science Magazine.

The team, whose work is supported by the Keck Foundation, was composed of physics graduate student Eric M. Dunham, professor of physics Jean M. Carlson, and postdoctoral researcher Pascal Favreau, who was based at UCSB's Institute for Crustal Studies. They modeled earthquakes using computer simulations of rapidly expanding three-dimensional ruptures along faults. They found that sections of the fault with increased material strength (called barriers) focus the earthquake's energy to an unexpected degree. This result comes as a surprise, since hard-to-break barriers were previously considered obstacles to the growing rupture.

The energy concentration has several important implications.

When barriers break, they release intense bursts of seismic waves that pose significant hazards to structures located near the fault. This explains puzzling records of the 1984 Morgan Hill earthquake that struck the area south of San Jose, California. During this quake there was an intense pulse of ground shaking traced to

a high strength region of the fault, rather than the rupture front which is typically the source of the strongest seismic waves.

Furthermore, the researchers are the first to show how this energy concentration drives the rupture ahead of where it would have been had the fault been easier to break. They showed that the rupture can even propagate faster than shear wave speed, typically considered the speed limit of growing earthquakes.

This "supershear" propagation, once regarded as a mathematical curiosity, has become an area of growing interest after experimental observations gave support to controversial reports of supershear bursts occurring during several major earthquakes.

First author Eric Dunham was awarded Outstanding Student Paper from the American Geophysical Union for this article. Jean Carlson and Pascal Favreau are listed as co-authors.

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