First Seconds of Earthquakes Tell All

By Larry O'Hanlon, Discovery News

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Nov. 10, 2005 — First impressions may be more reliable than ever when it comes to earthquakes, say seismologists.

A new study shows that contrary to what seismologists have long thought, the first shivers of a quake may actually give away clues to how much overall energy will be released — what's popularly known as the quake's total magnitude.

For years, earthquakes have been thought to work more like a cascading line of dominoes, the first little domino giving no hint about what's going to be toppled further down the line. But if the new finding is confirmed and the first few seconds of a quake can portend the rest of the shaking, it means earthquakes operate quite differently than thought.

It also suggests that earthquakes are the end result of a more subtle, silent slipping process yet to be detected in the Earth's crust.

"The bottom line of the cascade (domino) model is that you can't tell the magnitude of the earthquake until it's over," said geophysicist Richard Allen of the University of California at Berkeley.
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Allen and Erik Olson of the University of Wisconsin at Madison published a paper on the matter in the Nov. 10 issue of *Nature*.

When Olson and Allen studied the seismographs of the first few seconds of 71 earthquakes in California, Alaska, Taiwan and Japan, they began to see evidence that the energy released by the initial seconds of underground ruptures were scaled-down matches to the overall magnitude of the quakes.

That's exactly *not* what the cascading dominoes model predicts.

"An alternative model is that the small beginning (of a quake) is the last phase of some longer, slower, sub-seismic 'nucleation' process," suggested geophysicist Rachel Abercrombie of Boston University, who wrote a separate article in *Nature* commenting on Allen's and Olson's work.

That longer, slower process might be the gradual, silent and so far undetected slipping of faults that set the stage for the final quake.

Regardless of the cause, the discovery is good news for earthquake warning systems, said Allen. Even a few seconds of automated warning time can be helpful when a big quake hits, he said.

Although most people may not be able to react fast enough, warning systems in Japan, Taiwan and Mexico are already used to instantly warn planes away from airports (in case runways are being damaged), to sound alarms at schools and to automatically shut down processes at high-tech manufacturers where a lot of damage could be done by shaking. All of these things can save lives.

As for what it means for earthquake studies, the discovery is
another constraint that can be added to simulations of how faults work, said Allen.

That's particularly useful because constraints are in short supply to geophysical modelers, he said, who have very little information about exactly what is going on in the rupturing surfaces of faults during a quake.

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