Chinese earthquake provides lessons for future

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The May 12 Sichuan earthquake in China was unexpectedly large. Analysis of the area, however, now shows that topographic characteristics of the highly mountainous area identified the mountain range as active and could have pointed to the earthquake hazard. Topographic analysis can help evaluate other, similar fault areas for seismic risk, according to geologists from Penn State and Arizona State University.

The researchers note that "the landscape itself encodes information about the rates and patterns of tectonic activity," in an advanced online publication of *Nature Geosciences* today.

The ability to read these erosional landscapes is now good enough that researchers can use topographic analysis as a reconnaissance tool to identify areas of active rock uplift, according to Eric Kirby, associate professor of geosciences, Penn State. In remote mountainous areas, this approach can shed light on the activity of blind and hidden faults.

Kirby, working with Kelin Whipple, professor, School of Earth and Space Exploration, Arizona State University, and Nathan Harkins, graduate student, geosciences, Penn State, used topographic analysis of the area of the Sichuan earthquake to suggest a way to refine existing maps of earthquake risk in other places.

Previous studies using data from Global Positioning System satellites found the area had slow deformation rates that indicate modest strain

and seismic hazard, but this description contradicts the impression given by the rugged mountains. Similar terrain in the Himalaya Mountains is associated with rapid convergence -- tectonic plates moving toward each other.

Previously, Kirby and Whipple, focusing on geomorphic analysis, suggested that faults in the Sichuan region were active and were associated with regions of ongoing uplift of the mountains.

"The 2008 earthquake struck on one of the faults identified with high rates of rock uplift," says Kirby. "Topographic analysis can have potentially important implications for anticipating the likely locations of events in this area."

The researchers also believe that topography can indicate deformation of the crust at depth, even when short-term satellite measurements do not. For the Tibetan Plateau, this may be because crustal thickening occurs in an unusual way, through flow and deformation in the lower crust, rather than shortening of the upper crust. If this is correct, faults in the Longmen Shan range could be active, even without evidence of shortening across the mountain range.

"Where shortening rates are slow and satellite data may be ambiguous, topographic analysis can help guide the identification of potential earthquake risk," says Kirby.

The researchers looked at such things as anomalously steep river channel profiles extracted from digital elevation models, digital maps that represent changes in elevation of the land. They note that these methods were tested in areas where the actual tectonic activity levels were already known and that the Sichuan earthquake presents an ideal laboratory to further check the approach.

Source: Penn State