Himalayan megaquakes powered by elastic energy in Tibetan plateau

November 8 2006

Computer simulations indicate that Himalayan mega-earthquakes must occur every 1,000 years or so to empty a reservoir of energy in southern Tibet not released by smaller earthquakes, according to a paper that will appear in the Nov. 9 issue of the journal *Nature*.

Colorado researchers Roger Bilham and Nicole Feldl co-authored the paper "Great Himalayan Earthquakes and the Tibetan Plateau." Their research was funded by the National Science Foundation.

Bilham is a University of Colorado at Boulder geology professor and associate director of the Cooperative Institute for Research in Environmental Sciences or CIRES. Feldl is a research scientist at UNAVCO, a national Global Positioning System consortium founded by CU-Boulder and funded by the National Science Foundation.

In their report, the researchers reveal that earthquakes in the past 200 years in the central Himalaya, though catastrophic, have released relatively modest amounts of the energy of India's collision with the Tibetan plateau compared to three massive earthquakes that occurred in medieval times.

They base their claims on GPS point motions across the Himalaya that indicate where strain energy is stored. The researchers ran computer simulations on how the energy was released, which yielded clues on the approximate recurrence intervals of past Himalayan earthquakes.

In the past, experts resorted to estimating the timing of future earthquakes from the slip that occurred in former ones. However, the new information should help scientists forecast future seismic activity in the region, Bilham said.

"We had always assumed that earthquakes in the region were driven by the release of energy accumulating near the Greater Himalaya," he said. "Our recent calculations suggest that a substantial volume of the southern Tibetan plateau plays a significant role in driving great ruptures. Exhumation of ancient archives and surface ruptures are now needed to show the details of this process in the past 2,000 years to help us forecast future earthquakes - and save lives."

The Greater Himalaya forms a 2,000-kilometer arc separating northern India from Tibet and boasts the world's highest peaks, including the loftiest of all, Mount Everest, at more than 29,000 feet.

The region is highly prone to earthquakes and has produced some of the deadliest on earth. Last year, 74,000 people died in the Kashmir region during a relatively modest earthquake, 7.6 magnitude.

Computer simulations based on GPS data in the region reveal that the Tibetan plateau contains an invisible reservoir of "elastic strain energy" that is partly depleted each time an earthquake hits the region.

The researchers contend that only gigantic earthquakes could fully deplete this reservoir of strain. Their models also show what they call "two puzzling features of plate boundary seismicity."

"Our findings show that great earthquakes - those with a magnitude of 8.2 or greater - can re-rupture regions that already have ruptured in recent smaller earthquakes, or those with a magnitude of 7.8 or below," Bilham said.

Mega earthquakes, those with a magnitude of 8.4 or greater, apparently occur every 1,000 years and are driven by residual strain following centuries of smaller earthquakes, or those with a magnitude of 7.6 or lower, according to the Nature report.

The CU-Boulder researchers said conditions exist in the Himalaya today that could drive four or more earthquakes measuring more than 8.0 on the Richter scale. However, they added, these earthquakes would be even deadlier if they were delayed for another 500 years and occurred as mega-quakes exceeding 8.4 magnitude on the Richter scale.

Source: University of Colorado at Boulder