San Fernando, Northridge quakes may be maximum

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A new study by researchers at Oregon State University suggests that the magnitude 6.7 earthquakes that struck California's San Fernando Valley in 1971 and Northridge area in 1994 may have been about the most powerful quakes that this specific area can sustain.

Results of the research were published this week in the journal Geology.

"The study points out the potential of using paleomagnetism to estimate maximum earthquake magnitudes in some regions," said Shaul Levi, a paleomagnetist and professor emeritus in OSU's College of Oceanic and Atmospheric Sciences who was lead author of the study.

Co-authors were John Nabelek, a seismologist in the OSU College of Oceanic and Atmospheric Sciences, and professor emeritus Robert Yeats, from OSU's Department of Geosciences.

"Other researchers in the Los Angeles area have shown that the region could be hit by an earthquake of magnitude 7.2 to 7.5," said Yeats, one of the West Coast's leading earthquake geologists. "So the threat of smaller earthquakes in the area we studied should be welcome news to the area's residents.

"Further east, there is potential for larger earthquake magnitudes along the San Andreas fault system, which is capable of sustaining an earthquake up to about magnitude 8," Yeats added.

A magnitude 7.2 earthquake is roughly five times more powerful than a 6.7 quake, so downgrading the maximum magnitude is significant.

Paleomagnetism was used to measure the magnetization of sediments, which recorded the directions of the Earth's magnetic field when those sediments were originally deposited. From the magnetic orientations, the OSU scientists were able to discern that the crust in this area of rapidly expanding suburbs in northern Los Angeles County is broken up into blocks, rather than being a single piece of crust.

"From the size of the blocks, and data from the 1971 and 1994 earthquakes – which are the largest shocks recorded in this area – we calculated that the maximum earthquakes for the study area should be limited to magnitude of about 6.8," Levi said.

The OSU researchers originally set out to establish an accurate date for the Saugus Formation, which is widely distributed in north Los Angeles County, in the area bisected by Interstate 5. They found that the crust in this area had broken into four blocks, which are about 10 to 20 kilometers in length and width.

From the magnetic orientations, they concluded that the blocks at the Van Normal Lakes west of the city of San Fernando and at Soledad Canyon in the City of Santa Clarita had not rotated, while the block including the Magic Mountain amusement park rotated clockwise 30 degrees and another block farther east, north of the Foothill Freeway, recorded 34 degrees clockwise rotation.

This segmentation and block rotations are caused by stresses due to tectonic interactions between the colliding Pacific and North American plates. From the ages of the sediments and their paleomagnetic orientations, the researchers concluded that the blocks have acted independently for 800,000 years.

More detailed knowledge of the crustal structure will help disaster management planners make more informed decisions, the researchers say.

"When there aren't enough data," Yeats said, "managers tend to prepare for the worst-case scenario in a general sense rather than what the worst case may be for a particular region. Even though our study area sustained two damaging earthquakes in recent decades, it is not expected to endure earthquakes as large as those anticipated to the east and west."

The paleomagnetic methods used in this study could be applied to other areas to better assess the maximum potential for earthquakes. But, Levi warned, this technique depends on the availability of well-dated rocks of similar ages that have stable magnetization, suitable for paleomagnetism.

Source: Oregon State University