

[Home](#)
[Calendar](#)
[UCI-TV](#)
[News](#)
[Press Releases](#)
[Tipsheets](#)
[Experts](#)
[UCI in the News](#)
[Medical Center News](#)
[Profiles](#)
[Arts & Humanities](#)
[Education](#)
[Environment & Energy](#)
[Health & Medicine](#)
[Science & Business](#)
[Society & Culture](#)
[Resources](#)
[Graphic Standards](#)
[Style Guide](#)
[Meet the Media](#)
[Publications](#)
[Quick Facts](#)
[Fact Sheets](#)
[Statistics & Reports](#)
[Accolades & Distinctions](#)
[Chancellor's Site](#)


[Home](#) > [News](#) > [Press Releases & Media Advisories](#) > Press Release

Spanish explorers recorded first and possibly largest quake in Los Angeles history, say UCI researchers

1769 earthquake of estimated 7 or larger magnitude lifted Orange County coastline 3 to 11 feet; indicates active fault beneath San Joaquin Hills

Irvine, Calif., March 19, 2002

California's first recorded earthquake may have been the largest in the history of the Los Angeles basin and powerful enough to raise the Orange County shoreline more than 11 feet in some places, UC Irvine researchers say.

On July 28, 1769, Spanish explorer Gaspar de Portola and his men lay encamped on the banks of the Santa Ana River in what is now north Orange County. They felt a violent earthquake, followed by a number of aftershocks over the next several days. The Spanish measured the length of the shaking by the number of Hail Marys they could utter.

According to Lisa Grant, professor of [environmental analysis and design](#) at UCI's [School of Social Ecology](#), the "severe" earthquake described in Portola's July 31 diary entry may have had a magnitude of 7.3, significantly larger than the 6.7-magnitude Northridge earthquake of 1994.

With plants, pollens, shells and a nod to Portola, Grant and UCI colleagues Leslie Ballenger and Eric Runnerstrom have traced geological and historical records to determine that a major earthquake occurred sometime between 1635 and 1855 in the San Joaquin Hills, most likely in 1769. In findings to be published in the March edition of the Bulletin of the Seismological Society of America, the researchers describe uplift averaging 1.8 meters-about 5 feet, 10 inches-along the shoreline from Corona del Mar to Dana Point. The most obvious cause, Grant claims, is a major earthquake, probably along the "blind," or underground, fault in the San Joaquin Hills that Grant first detected in 1999.

"The San Joaquin Hills cover an area previously thought to have low earthquake potential," Grant said. "In findings published in 1999, we discovered that a large-magnitude earthquake could occur here; now we've discovered it has occurred. Our research may be the first documented evidence of an early historic or prehistoric blind thrust earthquake."

Grant and her research team used radiocarbon dating to determine the age of plants and shells from the elevated marsh bench, or ancient shoreline, in Upper Newport Bay and along the coastal San Joaquin Hills, finding that they must have been deposited no earlier than 1635. They measured the elevations of the marsh bench and the current shoreline and calculated the earthquake's magnitude from the amount of displacement it caused.

"The shoreline went up, and it went up quickly and by several meters," Grant said. "We knew an earthquake could do that, but there was no documented quake on the Pacific Coast prior to 1769."

So the researchers looked at the historical record of earthquakes since Portola's expedition, including an 1800 earthquake that cracked the walls of Mission San Juan Capistrano and an 1855 quake that may have generated a tsunami off Dana Point. Other researchers think the 1800 earthquake occurred further south or offshore, and the 1855 quake further north in Los Angeles County.

Finally, they studied data from the freshwater San Joaquin Marsh, which lies inland between UCI and Upper Newport Bay. Core samples from the marsh indicate a change in salinity that could have been caused by an earthquake lifting the marsh above sea level. And just above evidence in the sample of changed salinity, Grant said, "there are 'exotic' pollens-European pollens-which were introduced between 1776 and 1797."



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[March 2002](#)

[Feb. 2002](#)

[Jan. 2002](#)

[2001](#)

[2000](#)

[1999](#)

[1998](#)

[1997](#)

[1996](#)

[1995](#)

The pollens suggest that the earthquake occurred just before, or at approximately the same time that the Spaniards arrived in Southern California. The pollens were the final bit of evidence needed to date, locate and measure the earthquake that Grant believes is the earliest and largest in the history of the Los Angeles basin and to help map the elusive fault that generated it.

"Unlike faults that come to the surface, such as the San Andreas fault, subterranean faults-like the San Joaquin Hills fault and the fault that generated the Northridge earthquake-are difficult to map. We have evidence that an active fault exists, but what it looks like, we don't know," Grant said.

Grant's research was supported by UCI and the Southern California Earthquake Center with funding from the National Science Foundation and United States Geological Survey.

[[back to top](#)]