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Coastal Orange County fault could produce quake as large as 7.3, UC Irvine study shows

Previously undetected San Joaquin Hills fault stretches from Huntington Beach to Dana Point

Irvine, Calif., October 31, 1999

First evidence of a fault underlying coastal Orange County that could generate a 6.8- to 7.3-magnitude earthquake has been reported by a team of researchers led by Lisa Grant, an environmental analysis and design professor in UC Irvine's School of Social Ecology.

In findings presented in the November issue of Geology, the researchers describe a "blind thrust" fault (an underground fault) running about 24 miles from Huntington Beach to Dana Point beneath coastal mesas and the San Joaquin Hills. Preliminary findings reported in March estimated the fault could generate earthquakes as large as 7.1 about every 2,500 years. "But the fault is more active and the magnitude of a potential earthquake is greater than we first estimated," Grant said.

It is not yet known when the fault last generated an earthquake, but researchers say it has the potential to produce moderate to large earthquakes at 1,650- to 3,000-year intervals.
"Because it's in the subsurface, and we haven't yet experienced a major earthquake, we don't know the fault's boundaries precisely," Grant said.

It lies along the coastline in the area of a portion of the Newport-Inglewood fault, which generated the 1933 Long Beach earthquake. It runs roughly between the 405 Freeway and the ocean from Huntington Beach to the intersection of the 405 and I-5 freeways at the El Toro Y, then south under the San Joaquin Hills to Dana Point.

As in the case of the Northridge fault, which was undetected until the 6.7 earthquake in 1994, evidence of the coastal fault and other blind thrust faults is subtle. Grant had observed "bathtub rings" that indicated ancient beaches around the San Joaquin Hills, in Newport Beach's Back Bay and in Crystal Cove. The elevated beaches suggested a long and recurrent history of earthquake activity stretching back to the initial emergence of the San Joaquin Hills more than a million years ago. But their rate of uplift could not be determined without a scientific way to measure the rate at which the hills have been rising from the sea.

Grant needed not only a way to date the rings, but a team of experts from different disciplines to complete the research. The key, she learned, was coral—rare along the Orange County coastline, but particularly reliable in dating marine platforms. A year of detective work that began with a call to the Orange County Natural History Association led to a single coral in a dusty Santa Ana warehouse, then to a San Diego State University geologist with his own collection of corals and finally to a private collector in Long Beach whose 122,000-year-old San Joaquin Hills coral provided the key that proved Grant's hypothesis.

With her "Rosetta stone" of corals, Grant and the team of researchers she'd assembled determined that over the past 122,000 years the San Joaquin Hills have been rising about a quarter of a millimeter a year, or a total of more than 80 feet. The fault itself may be moving faster, perhaps three quarters of a millimeter per year, Grant said.

"Active faults that come to the surface, such as the San Andreas and Newport-Inglewood faults, have been recognized and mapped," Grant noted. "Now geologists are working on the more difficult ones. After the Northridge quake occurred, blind faults became a higher priority, and we're finding quite a few blind faults that we didn't know about 10 years ago.

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"While we can't predict earthquakes, the goal of research is to understand faults before they generate an earthquake. Last month's Hector Mine earthquake, for example, suggests that we should scrutinize older faults more closely and consider the possibility that they could generate an earthquake. Before Oct. 16, the fault at Hector Mine wasn't mapped as an active fault, and was not considered capable of generating a 7.1 earthquake."

In the case of the more recently discovered San Joaquin Hills fault, the researchers presume that it has repeatedly generated earthquakes during the past 122,000 years. "It would take many Northridge-sized earthquakes to create the San Joaquin Hills uplift we see today," Grant said.

"Now I'm looking for evidence that it's been active more recently--looking to see if it's moved within the past few hundred years," Grant said. She also will be investigating whether there's a relationship between the San Joaquin Hills fault and the Newport-Inglewood fault.

Grant is lead author of the Geology article with co-authors Eldon Gath, UCI professor of environmental analysis and design; Karl Mueller, University of Colorado; Hai Cheng and Lawrence Edwards, University of Minnesota; George Kennedy, San Diego State University, and Rosalind Munro, Leighton Associates in Irvine. Their research was supported by the Southern California Earthquake Center, with funding from the National Science Foundation, United States Geological Survey, UCI, Chapman University and the University of Colorado at Boulder.

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