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Study: Oil field operations caused California earthquakes

By **David R. Baker** Published 4:16 pm, Thursday, February 4, 2016



A person walks past pump jacks operating in Kern County. Researchers on Thursday said that injections of left-over water from oil field operations likely triggered a 2005 earthquake swarm in Kern County, the heart of California's oil industry. (AP Photo/Jae C. Hong, File) [less](#)

For the first time, scientists have reported that the underground disposal of wastewater from oil drilling has probably triggered earthquakes in California, a problem already rattling nerves in Oklahoma and other states.

Researchers on Thursday tied a September, 2005 swarm of moderate earthquakes in Kern County to three wastewater disposal wells nearby. The wells opened between 2001 and 2005, rapidly increasing the amount of wastewater stored underground near the White Wolf fault.

The **research paper**, published by the American Geophysical Union, could not prove with absolute certainty that the wastewater injections caused the quakes. Earthquake swarms, such as the one that hit San Ramon last fall, are hardly unusual in California. But the authors calculated only a 3 percent chance that the Kern County swarm was mere coincidence.

The study also does not offer any indication of how common such human-induced quakes may be in California. “However, considering the numerous active faults in California, the seismogenic consequences of even a few induced cases can be devastating,” the authors note.

America’s recent oil production boom created a strange side effect — earthquakes shaking places that rarely suffered them before. In 2015, for example, Oklahoma **experienced 907 quakes** larger than magnitude 3. Prior to 2008, the state **averaged just two** similarly sized quakes per year.

Scientists fixed the blame on injection wells, once considered the most environmentally responsible way for oil companies to deal with their wastewater.

Oil wells typically bring to the surface large amounts of mineral-laced water mixed with petroleum. Once separated from the oil, the water can either be treated for reuse, dumped into evaporation ponds or pumped back underground for disposal. As injection wells pump large volumes of water back underground — often into different rock formations than it came from — they can change the pressure within the rocks, making faults more likely to slip.

The emergence of hydraulic fracturing, which uses high pressure water to crack underground rocks, has produced even more oil-field water that needs disposal.

Wastewater injection wells can pose other problems. As detailed in **a Chronicle investigation** last year, California regulators for years let oil companies inject their wastewater into relatively high-quality aquifers that were supposed to be protected by law.

California ranks as America's third largest oil producing state, and one of its most seismically active. Many of California's oil fields — along with their injection wells — lie close to active faults, including the San Andreas. But California's frequent, naturally occurring quakes make it difficult for researchers to spot temblors that may have been triggered, at least in part, by human activity.

Scientists had previously tied quakes to underground injections of water into California's geothermal energy fields, but not to injections of oil-field waste water.

"You do have these swarms popping up unexpectedly in random places," said the research paper's lead author, Thomas Göebel, with UC Santa Cruz. "So we tried to be as rigorous as possible."

The quakes included in the new study, which struck near the Central Valley's southern edge, weren't large, with the most powerful registering magnitude 4.7. But injection wells have been linked elsewhere to quakes as large as magnitude 5.6, Göebel said.

"These are quakes that can be felt and can cause damage," said Shaye Wolf, climate science director for the Center for Biological Diversity environmental group. Her organization in 2014 issued a study that counted **350 injection wells** in California within 5 miles of an active fault.

"There probably have been other earthquakes induced by wastewater injection that haven't been documented, just because no one looked," Wolf said.

California's oil field regulating agency — the Division of Oil, Gas and Geothermal Resources — is trying to get a sense of how prevalent the problem may be, a spokesman said Thursday. The agency has commissioned Lawrence Berkeley National Laboratory to study the issue.

"The results of this study will aid in permitting and regulating future wastewater injection operations in the state," said division spokesman Don

Drysdale.

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