

# Scientists may be cracking mystery of big 1872 earthquake

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Aerial photo of the San Andreas Fault in the Carrizo Plain, northwest of Los Angeles. Credit: Wikipedia.

Geologists may be close to cracking one of the biggest seismological mysteries in the Pacific Northwest: the origin of a powerful earthquake that rattled seven states and provinces when Ulysses S. Grant was president.

Preliminary evidence points to a newly discovered fault near the town of Entiat in Chelan County, Wash. The find adds to a growing body of evidence that Central and Eastern Washington are more quake-prone than previously thought, and will help refine seismic risks in an area that's home to 1.5 million people, more than a dozen hydropower dams and the Hanford nuclear reservation, said Craig Weaver, regional chief of the U.S. Geological Survey's earthquake programs.

"For more than four decades, people have been guessing where the 1872 earthquake was," Weaver said. "To be able to finally pinpoint this thing on a map would be really important in helping us get the seismic hazard assessment correct in that part of the state."

The quake struck on the evening of Dec. 14, 1872, long before the first seismometer was installed in the Northwest.

The fact that chimneys cracked in Olympia, trees toppled in Puyallup and fissures split the ground south of Seattle led early observers to assume the quake was centered under Puget Sound.

But windows also shattered as far away as Victoria, British Columbia, and people were knocked off their feet at Snoqualmie Pass. The first analysis of newspaper reports from the time put the epicenter not far from Vancouver, British Columbia.

The most compelling eyewitness accounts, though, trickled in from east of the Cascades, in the sparsely populated hills near Wenatchee. Settlers and Native Americans reported a massive slide that briefly dammed the Columbia River. Some claimed that geysers spouted from the ground and gushed for months. Throughout Washington and Oregon, strong aftershocks kept the populace on edge for more than a year.

Subsequent studies proposed epicenters in the North Cascades and near

Lake Chelan. Estimates of the quake's size have ranged from magnitude 6.5 to 7.5, which would make it one of the biggest in recorded state history.

"No matter how you define it, that's a big earthquake," said USGS researcher Brian Sherrod, who led the modern-day hunt for the quake's source. "It was felt from Montana and British Columbia down into Oregon and Northern California."

In the 1970s, legions of consultants employed by utilities with nuclear ambitions attempted to pin down the location of the quake. One consortium wanted to build three reactors at Hanford, while another proposed a pair on the Skagit River near Sedro-Woolley. Neither project wanted to be near where the 1872 quake was centered.

The result was a series of reports that put the epicenter back and forth across the Cascades. A Seattle politician called it "the earthquake that wouldn't stay put."

No one was able to find the fault.

Beginning six years ago, Sherrod brought a new tool called LiDAR to bear on the puzzle. The technique allows scientists to virtually strip away vegetation and generate detailed topographic maps by beaming laser pulses from an airplane and analyzing the way the signals bounce back.

The area near Entiat was already a prime suspect as the source of the quake, based on eyewitness reports and recurring swarms of small quakes. The first LiDAR images didn't show much, though, so the USGS commissioned another sweep in 2013.

"When I looked at those, it just popped out," Sherrod said in late October as he led a team of geologists down a fire-blackened hillside in

the Okanogan-Wenatchee National Forest and into a small valley that drains into the Columbia River.

He pointed to a faint ridgeline a few feet high that snaked across the landscape like an oversized mole track. "That's the scarp."

A scarp is a scar created when an earthquake ruptures the ground surface. This one extends at least 3.5 miles, bearing witness to a major upheaval in the recent past, Sherrod said.

"Clearly we have a fault. There's no doubt about it," he said, scrambling into a 15-foot-long trench cut perpendicularly across the scarp. He named it the Spencer Canyon fault, after the drainage where it's located.

The steep terrain and winding road ruled out the use of a backhoe, so Sherrod and his team dug two trenches by hand.

In the exposed dirt walls, Sherrod traced the diagonal line that marks the fault. Soil layers on one side are higher than on the other, he explained, revealing the way the ground jerked during past quakes.

Scraping the walls of the trenches and using colored pins to delineate layers, the geologists have uncovered evidence of at least two quakes, and perhaps as many as four.

But did the most recent one strike in 1872?

The evidence isn't definitive, but it points in that direction, Sherrod said.

The fault isn't far from Ribbon Cliffs, the scar of a huge landslide along the Columbia River that is likely the one reported by witnesses in 1872. Highway 97 runs below the cliff, and islands in the river are remnants of the slide.

In Spencer Canyon, the fault scarp itself is buried in one spot under a much smaller landslide. When Sherrod and his colleagues dated trees growing on the slide, they found the oldest sprouted sometime around 1880. The slide impounded a stream, forming small ponds that drowned several trees. Tree-ring dating showed those trees died around the same time period.

For geologist Jim Miller, of the consulting firm GeoEngineers, that's almost slam-dunk evidence that the fault was responsible for the 1872 quake. "The information I've got right now gets me to the 98 percent confidence level," said Miller, who helped Sherrod excavate the trenches and examine the scarp.

Sherrod is still hedging his bets.

He and his colleagues collected bits of charcoal, wood and volcanic ash from the trenches. Radiocarbon dating and chemical analysis of the ash should help them establish the oldest possible age of the most recent quake, he explained. They also hope to determine roughly when earlier quakes occurred, to get some idea of how frequently the fault might snap in the future.

The results will be of keen interest to Columbia River dam operators, Miller said. He has been working with Douglas County Public Utility District, which operates Wells Dam, to re-evaluate the risk posed by earthquakes. Similar reviews are under way for several other dams in the area.

The possibility of an 1872-type quake was factored into the safety equation when the dams were built. But knowing exactly where the fault is will provide a better picture of how the ground is expected to shake the next time it snaps, Weaver said.

"The more certain you can be about the hazard and ground motions, the more certain the engineering solutions can be."

Weaver said it's not clear what, if any, implications the Spencer Canyon Fault might have for nuclear-waste-storage facilities and the Columbia Generating Station, Washington's sole nuclear-power plant. Both are located more than 100 miles away at Hanford.

Seismic safety at the nuclear-power plant is under review, with a report expected next year.

Over the past decade, Sherrod and his colleagues have discovered several other new faults east of the Cascades, along with evidence that some known faults are larger-and therefore more dangerous-than geologists used to think.

Collectively, the new evidence shows that while the region isn't as seismically active as Western Washington, it's far from immune from damaging quakes.

Locating the source of the 1872 [quake](#) would help fill in that picture, Sherrod said.

And for a geologist, what could be cooler than playing sleuth in a 142-year-old mystery story?

"This is pretty exciting stuff for us," Sherrod said.

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