Scientists perform quake research on Carrizo Plain

Team digs trenches and collects bits of charcoal to better understand past temblors and when the next big one may hit

David Sneed, San Luis Obispo Tribune, 8-7-11

On the morning of Jan. 9, 1857, a 225-mile segment of the San Andreas Fault ruptured, creating a magnitude-7.9 quake centered under eastern San Luis Obispo County. It was one of the most powerful earthquakes ever recorded in the United States.

More than a century and a half later, researchers are using advances in technology to study the San Andreas Fault where it slashes through the east side of the Carrizo Plain. Their research has already rewritten the scientific understanding of how often the San Andreas produces earthquakes.

The stakes are high.

The 1857 event was the last time the southern section of the fault, running from Parkfield in southeastern Monterey County to the Salton Sea, produced a quake. Many seismologists worry that the fault is "locked and loaded," overdue for another large quake.

"What happened in 1857 is an analog for what can happen again," said Lisa Grant Ludwig, a seismology professor at UC Irvine who has spent more than 20 years studying the San Andreas Fault.

The 1857 Fort Tejon quake — so named because the fort was one of the few populated places near the fault — killed only two people. The damage caused by a similar event today "would easily run into the billions of dollars, and the loss of life would likely be substantial, as the present-day communities of Wrightwood, Palmdale, Frazier Park and Taft (among others) all lie upon or near the 1857 rupture area," according to the Southern California Earthquake Data Center.

Last year, Grant Ludwig and her colleagues caused a stir in the scientific community when they published a paper in the journal Geology stating that the San Andreas generates quakes more frequently than previously thought. The paper was based on excavations into the fault the group had done on private land in the Carrizo Plain.

Early research concluded that big quakes typically occurred at intervals from 235 years to as many as 450 years. The new research shows the typical interval between quakes is 100 years, but somewhat longer between big quakes.

"The elapsed time since the last major earthquake (153 years) is considerably more than the average time interval of this section of the fault, but also similar to the average time between 1857-like M7.9 earthquakes (about 150 years) if the interpretation presented here is correct," concludes the 2010 paper.

Using academic caution, Grant Ludwig is reluctant to give dire predictions about the likelihood of "the next big one" rocking Central and Southern California. Faults and the earthquakes they produce are notoriously unpredictable.

For example, it is possible that the fault could rupture over a small section, producing a smaller quake, or it could similarly release its pent-up energy through a series of smaller, less destructive quakes.

“But it’s fair to say that a potential exists (for a large, destructive quake), and we are concerned about that,” she said.

San Andreas on display

Nowhere is the awesome tectonic power of the San Andreas on better display than at Wallace Creek in the Carrizo Plain National Monument. The creek flows out of the Temblor Range and takes a 420-foot dogleg to the right when it reaches the fault.

That’s how much a series of quakes has moved the fault over the past 3,800 years. If that movement is averaged out, it comes to 1.3 inches a year or about the same rate that a person’s fingernails grow.

“It’s the best measurement of anywhere along the fault,” Grant Ludwig said. “This is where you come to see the fault, taste it, feel it.”

Grant Ludwig and her small team of researchers from UC Irvine and Arizona State University at Tempe returned to Wallace Creek this summer and dug three 10-foot-deep trenches across the San Andreas.

Their main goal was to recover small bits of charcoal that have been deposited by the creek in the rupture zone of the fault during its recent geologic history.

Using radiocarbon dating, researchers can determine the age of the charcoal bits and pinpoint when each temblor occurred.

Researchers had opened trenches at the same locations in the early 1980s and had recovered charcoal samples.

However, the radiocarbon technology of 30 years ago required samples as large as a pebble. Today’s technology can date a sample as small as a rice kernel.

That’s significant, explained Sinan Akciz, Grant Ludwig’s postdoctoral research assistant. In the arid Carrizo Plain, it can take decades, even centuries, for a larger chunk of charcoal to be washed downstream from the Temblor mountains to the fault. Smaller chunks can make the journey in a year or more, greatly increasing the accuracy of the dating.

On a recent sundrenched morning at Wallace Creek, researchers were busy examining one of the trenches. Its sheer vertical walls display the geologic history of the fault going back 4,000 years.

Layers of round cobble show where prehistoric creeks flowed across the fault. Rows of nails the researchers inserted into the wall trace the tracks of smaller faults.

These are all subtle clues to past geologic activity. Grant Ludwig’s team photographed the walls and will stitch the pictures together into a large panorama for later study.

This type of research has already produced a more accurate picture of the dramatic events at Wallace Creek the morning the Fort Tejon quake struck. Geologists initially estimated the amount of slippage along the fault to be 9.5 meters, or a whopping 31 feet.

Grant Ludwig's research puts the slippage at 5 meters or about 16 feet, considerably less than the previous estimate but still a substantial amount.

To visualize this, imagine that two people were standing on either side of the fault directly across from one another when the quake occurred — they would have been 16 feet apart when it finished.

Research at the Wallace Creek site has finished for the summer. Grant Ludwig plans to return for more research next summer pending receipt of the needed funding and permits.

San Andreas fault has produced deadly quakes

The San Andreas Fault is where the North American tectonic plate rubs against the Pacific plate. North America is moving south while the Pacific is moving north.

It runs 810 miles from Cape Mendocino in Northern California to the Salton Sea in the Southern California desert. The San Andreas has produced some of the nation's most deadly quakes.

Most notable was the 1906 San Francisco earthquake, which produced a magnitude-7.9 jolt, the same as the Fort Tejon quake. More than 3,000 people died in the San Francisco shaker and the resulting fires — the greatest loss of life from a natural disaster in California's history.

The magnitude-6.9 Loma Prieta earthquake in 1989 killed 63 people in the San Francisco Bay Area. Most recently, a magnitude-6.0 quake shook Parkfield in 2004.

The segment of the San Andreas at Parkfield, northeast of Shandon, is something of an anomaly. It has a history of producing medium-sized quakes every 22 years, earning the town the nickname of the Earthquake Capital of the World.

This high frequency of quakes has also made Parkfield the most closely observed earthquake zone in the world. The U.S. Geological Survey began work there in 1985. In 2004, scientists began studying earthquakes using a 2.5-mile-long hole bored into the fault.