

Barrels, Earthquake Tests, and the Yountville Quake

A Wake-Up Call for the California Wine Industry

by *Mick Winter*

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If the quake were slightly larger or longer the stacks in this row would have toppled.

Photo: Joshua Marrow

On July 28, 2000, an earthquake demonstration was held at the **University of California** at Berkeley's Pacific Earthquake Engineering Research Annex in Richmond, California. Engineering graduate student **Joshua Marrow** used the largest seismic simulator in the United States to test the effect of a scaled-down 7.2 magnitude earthquake on an 18-foot high stack of 12 wine barrels.

As a *Wine Business Monthly* reporter noted: "The barrel stack swayed from side to side for only a couple of seconds before pitching forward and collapsing. Only the safety-restraints on the barrels and racks prevented the barrels from falling to the ground and causing the 700 gallons of water contained therein to flood the lab."

On September 3, 2000 a *real* earthquake demonstration was held in the Napa Valley, but no stacks of barrels collapsed. The quake measured 5.2 in magnitude. Its epicenter was in the hills west of the Napa Valley, three miles west-southwest of the town of Yountville, and nine miles northwest of the city of Napa. To be precise, it was at 38.377 degrees latitude and 122.32 degrees longitude.

While not a major earthquake, the "Yountville Quake" caused extensive damage in the city of Napa. In fact, the damage was much greater than one would expect for the size of the quake.

According to the **U.S. Geological Survey**, the "Peak shaking levels in the city of Napa were amplified five to eight times relative to a station located in the mountains less than a mile from the earthquake epicenter. Both the high levels and local amplification help explain the surprising concentration of earthquake damage through the city."

The highest recorded level of shaking was at a fire station north of the city of Napa, approximately six miles from the epicenter. The shaking there was 50 percent of the force of gravity. This means that the buildings at the site were subjected to a horizontal force that was 50 percent of the building's weight. A station located south of town, near Napa Valley College, recorded a peak shaking level nearly as high. "Both recordings are substantially higher than expected for a magnitude 5.2 earthquake and are consistent with the significant damage that the city suffered," said **Mary Lou Zoback**, chief of the USGS Earthquake Hazards Team in Menlo Park.

While earthquake shaking levels depend on the distance from the earthquake source, the high level of ground shaking in Napa also appears to be the result of two other factors: first, the amplification of shaking by young sediments along the Napa River, and second, the focusing of strong motion to the southeast, the direction the earthquake rupture propagated.

But amazingly there were few reported problems at Napa Valley wineries. Although there are several wineries within a few miles of the quake's epicenter--among them **Mt. Veeder Winery, The Hess Collection, Chateau Potelle** and **Havens Wine Cellars**--significant damage from the quake did not occur near the epicenter but rather further away as waves radiated out from the epicenter and passed through alluvial land.

The Hess Collection, in the hills in northwest Napa, lost a few bottles and had some of the paintings in their art collection go slightly askew. Havens Cellars, in the valley floor on the west side of Highway 29 between Napa and Yountville, lost a half-dozen champagne flutes and a ceramic vase, and had some barrel chocks loosened. **Domaine Chandon**, further north on the west side of Yountville, reported no problems at all.

The greatest damage appeared to take place 5-8 miles in a southeasterly direction from the epicenter. That was where many Napa homes and businesses suffered serious damage. President Clinton declared Napa a disaster area in order to deal with the \$50-\$100 million dollars in damage the city's residents experienced. In addition, 25 people were injured, two of them critically.

Seismic engineer Joshua Marrow has visited the area extensively since the quake and reports that "damage was very bizarre. Wineries to the north, west and directly east almost didn't even feel the earthquake. Being at the epicenter was almost like being in the eye of a hurricane, particularly since they were on rock or firm soil. Because of the way the waves propagated, facilities in Oakville, Yountville and Rutherford didn't even lose champagne flutes off the shelves. The ground motion was very low there."

But in Napa, things were very different. Many residents saw television sets shoot horizontally across the room, and dishes, glasses and pantry contents ended up on their floors. Numerous chimneys were damaged and other structural problems were common.

Some wine production facilities in south and southwest Napa lost barrels. Fortunately, they were empty because they were preparing for crush. The earthquake was 18 seconds long and strong ground motion lasted only 4-5 seconds. Nevertheless, even at that short time, many barrels were on the edge of collapse. Marrow says that if the earthquake had gone on much longer or had been any more severe, it would have been very serious.

"This quake was a good wake-up call," said Marrow. "There are a lot of people who believe that the Sonoma and Napa Valleys are isolated from earthquakes. This one showed we can have a serious quake right here. And it was on an unknown fault. Yet seismologists report that the fault with the highest probability of a 7.0 or higher earthquake in the next 30 years is the Rodgers Creek Fault, which is west of

the Napa Valley and is actually the north section of the Hayward Fault. According to the USGS, the Rodgers Creek Fault has a 32 percent probability of experiencing a magnitude 6.7 or greater earthquake in the next 30 years. This is the highest probability of any fault in the San Francisco Bay Area."

"If the Yountville Quake had been a 5.4 instead of a 5.2--which in terms of energy released would be four times as powerful--we would have seen a whole different level of damage," said Marrow. "One concrete warehouse in west Napa, built in the late '60s, had to be red-tagged and everyone inside evacuated. It's going to take extensive repairs to bring it back to pre-earthquake condition. This is indicative of what other wineries will see in an even slightly larger quake." **wbm**