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After a 5.7 earthquake, Utah seismologists investigate a 'virtually unknown' fault

(Francisco Kjolseth | The Salt Lake Tribune) University of Utah seismologist Amir Allam deploys 43 portable seismic instruments to be buried along the Wasatch Fault above Salt Lake City on Tuesday, March 24, 2020, to capture data following last week's 5.7 magnitude earthquake.

By Brian Maffly • Published: 14 hours ago
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Soon after Salt Lake City stopped shaking March 18 from its strongest earthquake on record, Amir Allam, a University of Utah seismologist, knew he had to get busy if he hoped to closely study the hundreds of aftershocks he knew would follow the 7:09 a.m. jolt.

The fault that is believed to have moved along the eastern base of the Oquirrh Mountains is virtually unknown, and here was a chance, dropping out of the blue, to image it.

But Allam had a problem.

All 210 of the U.’s portable seismographs, loaf-sized instruments known as nodal geophones, were currently deployed along California’s San Andreas fault and elsewhere, and, therefore, were unavailable for what he needed to do in his own backyard. The Salt Lake Valley hadn’t had a sizable shake since 1962 and last week’s 5.7 magnitude earthquake offered a rare opportunity to better map the network of fractures under the valley.

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Allam and his U. colleagues quickly mustered up dozens of geophones from other institutions and began burying them near the epicenter of the initial quake, likely on a fault that has remained a mystery to Utah seismologists.

They hope to characterize it and determine how it is interconnected with the Wasatch fault running along the base of the foothills on Salt Lake City’s east side and its lattice of associated faults, or “strands.”

‘Jury is still out’

“We started immediately the morning of the [initial] earthquake, and we have been installing them ever since,” Allam said Tuesday as he unloaded shovels and 43 geophones from his truck. “These are the last bunch.”

He already had deployed 139 geophones, each equipped with 35 days of battery life, around the Salt Lake Valley, each measuring ground movements — vertical, north-south and east-west — from hundreds of aftershocks. These recordings will help scientists with the U., as well as the Utah and U.S. geological surveys, to characterize this intriguing fault.

The Wasatch fault system's network of cracks in the earth stretches 230 miles from Malad, Idaho south to Fayette, Utah through Utah's major metropolitan area, where at least 80% of the population resides. A magnitude 6 quake on the main fault could cause severe damage, depending on where it strikes. A 2016 report forecast a 57% chance of such a quake or stronger within the next 50 years. Scientists do not believe last week's temblor will reduce the chance of a major quake on the Wasatch fault down the road.

"We want to map out the basin depth all over the valley. We actually don't know it [the fault network] that well," Allam said. "... We want to capture as many tiny aftershocks as we can, so we have a really dense deployment around the epicenter of the 5.7 quake. We want to get that fault structure. We want to know exactly how the Wasatch and its subsidiary faults are changing their patterns in the subsurface."

The fault that likely moved dips to the west and is not expressed on the surface, according to Kris Pankow of the U. Seismograph Stations. It could be the same one that shook Magna in 1962 with a magnitude 5.2 quake that touched off a swarm of lesser aftershocks, but it can't be known for sure because the instrumentation was not in place to precisely locate that quake.

"The jury is still out on the specific fault that moved and produced [the March 18] earthquake," said Ryan Gold, a research geologist with the U.S. Geological Survey. "The specific strand, that's what we are trying to sort out. Additional instrumentation is being installed to monitor ongoing seismicity."

'Aftershocks are going to diminish’

(Francisco Kjolseth | The Salt Lake Tribune) University of Utah seismologist Amir Allam deploys 43 portable seismic instruments to be buried above Salt Lake City on Tuesday, March 24, 2020, to capture data following last week's 5.7 magnitude earthquake.

In the week since the main quake, the ground under Magna has kept shaking.

As of Tuesday at 4 p.m., 456 aftershocks had been recorded, according to Gold, coming at an average rate of one every 20 minutes. At least 29 were magnitude 3 and a handful exceeded magnitude 4. The fault released a magnitude 3.1 temblor Tuesday at 5:32 a.m., followed by many stronger than magnitude 2. Most were located very close to the original epicenter a few miles north northeast of Magna and just six miles beneath the surface.

“The number and size of aftershocks are going to diminish with time but within these sequences. It’s the fault adjusting to the changes in stress. They are kind of chattering,” said Pankow, who is also closely monitoring aftershocks with larger seismographs placed in a few strategic locations. “With time, that stress is going to dissipate.”

The larger instruments are connected to broadband, providing real time data on the aftershocks. Meanwhile, satellite imagery shows the ground moved several centimeters at the surface as a result of the main quake, according to Gold.

The aftershocks don’t occur in steady intervals but in clusters, according to a graphic representation posted by Seismograph Stations. In the first three days after the mainshock, dozens of aftershocks flared. They grew weaker and less frequent until Sunday night, when a magnitude 4 struck, followed quickly by numerous aftershocks.

“That magnitude 4 was its own stress release; it has its own set of aftershocks to go with it,” Pankow said. “We might have some more magnitude 4s before this is all done.”

Seismometers, types of seismograph that measure surface ground movement, are installed in at least three major historic structures in downtown Salt Lake City: the Utah Capitol, City Hall and West High School. These instruments record direction, intensity and duration of earthquakes. The data generated by these instruments helps engineers understand the seismic forces buildings on the Wasatch fault system could be subject to, according to Pankow.

Hillside research

(Francisco Kjolseth | The Salt Lake Tribune) University of Utah seismologist Amir Allam unloads 50-pound bags filled with portable seismic instruments to be buried near the Bonneville Shoreline Trail on Tuesday, March 24, 2020, to document the aftershocks from last week's 5.7 event.

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An assistant research professor in the U.'s Department of Geology and Geophysics, Allam teaches jiu jitsu on the side. On Tuesday, he recruited some of his students on a moment's notice to help schlep instruments into the hills above Salt Lake City's Avenues neighborhood as the weather deteriorated in front of a snowstorm expected to arrive by Wednesday.

They hoisted 50-pound satchels over their shoulders, each holding six geophones, and trekked a half-mile up the Bonneville Shoreline Trail to a spot where Allam had identified a 500-meter transect along a ravine that was just starting to green up with the coming of spring. Here the team was to plant the geophones along a preselected line spanning a known strand of the Wasatch fault in the undulating terrain overlooking the city.

As a cold rain began to fall, the crews dug 8-inch holes in 13-meter intervals along a downsloping ridgeline on a roughly north-south axis. The geophones were placed in the holes, oriented directly north, and covered with dirt.

In a month, Allam and his associates will return to recover 182 geophones around the valley. The harvest is hoped to yield a bounty of data that paints a valuable picture of what lurks beneath Utah's most populated region.

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