Slickrock: Geoscientists explore why Utah's Wasatch Fault is vulnerable to earthquakes

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From left, USU geoscientists Srisharan Shreedharan and Lindsey Broderick collect rock samples from the Wasatch Fault near Brigham City, Utah, USA. Credit: Alexis Ault

About 240 miles long, Utah's Wasatch Fault stretches along the western edge of the Wasatch Mountains from southern Idaho to central Utah, running through Salt Lake City and the state's other population centers. It's a seismically active normal fault, which means it is a fracture in

Earth's crust that has moved many times in the past.

"Normal faults are observed along different tectonic systems, where the tectonic plates are moving apart," says Utah State University geophysicist Srisharan Shreedharan. "The Wasatch Fault forms the eastern edge of the Basin and Range geologic province, which has stretched and broken over millions of years."

Shreedharan, assistant professor in USU's Department of Geosciences, says normal faults generally look like two slabs of rock, where one slab, the "hanging wall," moves downward relative to the other slab, the "footwall."

"The dip angle of the sliding surface tends to be steep, often between 45–90 degrees," he says. "The Wasatch Fault plunges, toward the west, at a steep angle at the surface in the Salt Lake City area."

A steep angle could mean seismic activity may be dampened during an earthquake and spare inhabitants and buildings from much injury and damage on the surface.

"But the 2020 Magna earthquake, which occurred at about 9 kilometers depth west of Salt Lake City, caused injuries and resulted in nearly $50 million in property damages," Shreedharan says. "It was a wake-up call. We want to understand how and why it happened at such a shallow depth , if the Wasatch Fault dips so steeply at the surface."

With USU Geosciences Associate Professor Alexis Ault and doctoral student Jordan Jensen, Shreedharan has published new findings about why earthquakes occur along the Wasatch Fault and why communities along the fault are more vulnerable to earthquake damage than previously thought. Their paper appeared in the April 25 online edition of *Geology*.

Using rock samples collected from the fault, Shreedharan combined experiments and analysis in his Rock Deformation and Earthquake Mechanics lab with Ault's investigative expertise in earthquake geology and fault rock textures at USU's Microscopy Core Facility. Their research revealed significant clues about the Wasatch Fault's earthquake risk.

"Although the Wasatch Fault dips sharply at Salt Lake City, it curves more gently at depth as it moves west and is probably oriented at a much shallower angle at earthquake depth than expected," Shreedharan says. "This means that an earthquake rupture could lead to stronger, more intense shaking at the surface—meaning a greater chance of injury and destruction."

Further, the scientists discovered earthquake slip is possible along the shallowly dipping portion of the Wasatch Fault because the fault rocks themselves are much weaker—worn down and slicker—than the surrounding, undamaged rock.

"It turns out this weak frictional behavior, which we characterized with deformation experiments and microscopy, is a product of deformation that happened more than 1.7 billion years ago when what is now the Wasatch Fault was at even greater depths within Earth," Ault says. "Repeated past earthquakes since then have further modified the fault properties through time, priming the fault rocks to fail again in a future event."

Understanding how one rock is frictionally weaker than another, Shreedharan says, is like comparing ice to sand.

"You can envision how slick rock can slide more easily and at lower angles than a rock with a rough surface," he says. "This process is happening continuously, though at a very slow pace, under our feet."

More information: Srisharan Shreedharan et al, Frictional and microstructural evidence for a weak Wasatch fault zone, *Geology* (2025). DOI: 10.1130/G52606.1

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