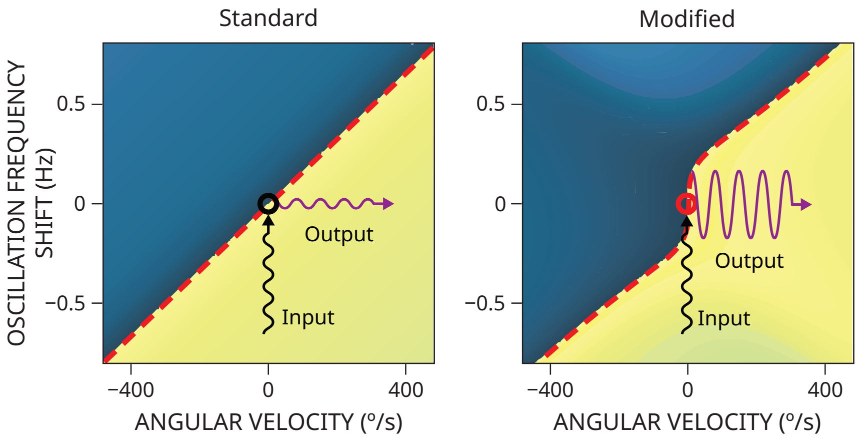

Figure 2. For a standard Coriolis vibratory gyroscope **(left)**, the change in the oscillation frequency is linear relative to the angular velocity that produces it. By modifying the standard design **(right)**, researchers were able to tune the system and produce a larger frequency shift response, particularly for small angular velocities, as shown by the dashed red line. (Figure adapted from ref.1.)

the Coriolis effect—the deflection of a moving object subject to rotation. The standard configuration for chip-scale gyroscopes involves a disk resonator made of concentric rings connected by spokes that undergoes horizontal and vertical oscillations, represented by the red and blue springs in figure 1. The Coriolis response in such devices is essentially linear: A small rotation yields a proportionate, small change in the oscillation frequency.

Research aimed at improving the precision of small-scale gyroscopes often focuses on noise reduction. Drawing inspiration from recent work on optical gyroscopes, Jing, Zhou, and colleagues wondered whether they could alter the device to instead amplify the response signal. They found that by tuning the stiffness of the system along a third orientation between the vertical and horizontal oscillations, represented by the green spring in figure 2, they could alter the system response so that the effective Coriolis factor—the change of oscillation frequency relative to the angular velocity—increased by three orders of magnitude.

The study serves as a proof of concept for how to build chip-scale gyroscopes with higher sensitivity, but additional work is needed for such devices to be commercially viable. To tune the frequency response of the system, the researchers needed to precisely calibrate the coupled stiffness. It will be a challenge to maintain that precision under real-world operating conditions. The nonlinear signal also complicates the translation of the signal into a measurement because it requires more complex calculations and calibration, which would need to be accounted for in a commercial design.

Many settings where gyroscopes are already used would benefit from increased sensitivity and precision, such as in vehicles and cameras for stabilization, in surgical devices for movement tracking, and in places where GPS calibration is unavailable. "The key idea," says Zhou, "is not limited to one specific gyroscope design." He says the principle behind the design "may be useful in other inertial sensors and possibly in other precision measurement systems where weak perturbations need to be detected." PT

Reference

1. S. Zhang et al., "Cusp-singularity-enhanced Coriolis effect for sensitive chip-scale gyroscopes," *Nature* **653**, 700 (2026).

Fault movement may affect erosion as far as 100 km away

Land that has been damaged by the cumulative activity of faults may be more susceptible to geomorphological changes, like landslides.

By Sarah Wells

Crustal movement along fault lines sculpts the land by triggering earthquakes, reshaping rivers, and uplifting rocks, such as those shown in figure 1. It's well known that along with producing earthquakes that cause sudden damage through pulverization, active faults can gradually fracture and weaken rock that is up to a kilometer away. To better understand how far the tectonic damage may reach, Boontigan Kuhasubpasin (then at UCLA) and

Figure 1. These rocks at the Vasquez Rocks Natural Area park in Southern California are the result of uplift caused by tectonic movement along the San Andreas Fault. In new work, researchers observed signs of fractured rock and high erosion rates in areas up to roughly 10 km from that fault. (Photo by iStock.com/hmlCA.)

colleagues analyzed erosion rates at river basins worldwide.[1] They determined that erosional efficiency, a measure of how effectively eroding forces move material away, was elevated as far as 100 km from an active fault. The research team also proposed that repeated shaking from earthquakes compounded the effects over time, making rock more susceptible to geomorphological changes caused by weathering or landslides.

Unlike earthquakes, erosion takes place over millennia. To understand how a landscape changed over time, researchers can measure the concentration of the long-lasting isotope beryllium-10. Cosmic rays interacting with quartz near Earth's surface produce *in situ* ^{10}Be, which accumulates in the upper few meters of exposed rock. High ^{10}Be concentrations indicate relatively slow erosion, whereas low concentrations suggest rapid removal of near-surface material by erosional processes. Kuhasubpasin and colleagues looked at more than 1700 ^{10}Be-derived erosion rates from

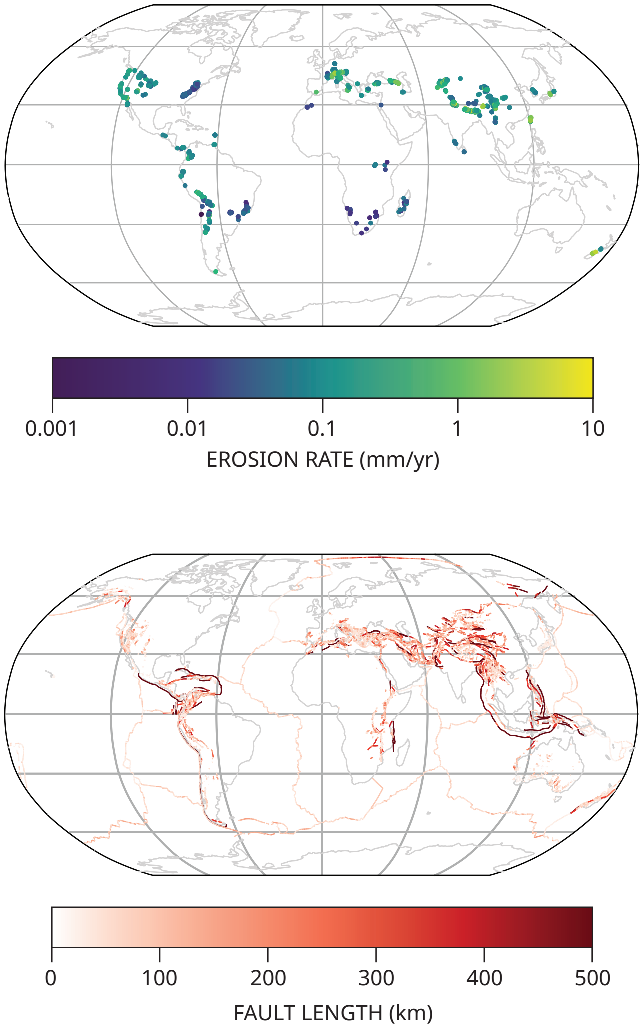

Figure 2. Global maps of both the erosion rates calculated from concentrations of beryllium-10 at river basins **(top)** and the distribution of active faults **(bottom)**. The highest rates of erosion are shown in yellow and green, and the longest faults are shown in dark red. Using statistical modeling and machine learning, the team compared the maps and found that distance from faults had more influence on erosion than did other potential factors. (Figure adapted from ref. 1.)

across the globe and then analyzed potential sources of the erosion in those areas. The factors included mean annual precipitation, rock type, distance from active faults, and a measure of seismic shaking intensity called peak ground acceleration.

Using statistical and machine-learning models to evaluate the influence of those factors on erosion, the team found that the distance from an active fault was the primary predictor of erosional efficiency in the sampled area. Figure 2 illustrates that relationship. Erosional efficiency was at its highest up to 15 km away, and it was still elevated up to 100 km away. The team also found that the effects were strongest near large reverse faults, where rock that lies above the fault plane is forced up, and that there was a positive correlation between erosional efficiency and peak ground acceleration. To support their data analysis, the researchers analyzed previous field measurements taken near the San Andreas Fault in California. They observed signs of fractured rock and higher erosional efficiency in areas up to roughly 10 km from the fault, though not in areas beyond that distance.

The finding suggests that repeated exposure to seismic shaking can contribute to the weakening of surrounding rock by disrupting grain boundaries and expanding fracture networks. There are still uncertainties, including how grain-to-grain disturbances propagate through rock and influence sediment dynamics, that researchers can work to better understand, says Kuhasubpasin. Altogether, the work offers a new way for researchers to understand the role of tectonic damage in geomorphological change, especially in regions where it was previously underestimated. **PT**

Reference

1. B. Kuhasubpasin, S. Moon, C. Lithgow-Bertelloni, “Role of tectonic rock damage in erosional processes: A global analysis,” *Science* **392**, eady9857 (2026).