

THE *Current*

August 13, 2025

[Harrison Tasoff](#)

Years after an earthquake, rivers still carry the mountains downstream

On May 12, 2008, the magnitude 7.9 Wenchuan Earthquake shook central China, its destructive tremors spreading from the flank of the Longmen Shan, or Dragon's Gate Mountains, along the eastern margin of the Tibetan Plateau.

Over 69,000 people died in the disaster, nearly a third are thought to be from geohazards like the more than 60,000 landslides that rushed down the slopes of the Longmen Shan.

After more than a decade and a half of work, scientists finally have an account of the fate of the landslide debris. Surveys of a reservoir downstream of the epicenter revealed how and how quickly the region's major river moved this sediment, as well as the effect it had on the river channel itself. The [results](#), published in *Nature*, suggest that the hazards caused by megaquakes may last long after the ground has settled. What's more, they offer insights into a fundamental question of Earth science: How do earthquakes build mountains?

Shaking the mountains loose

The Wenchuan Earthquake delivered rock and soil into the region's streams and rivers. Researchers are interested in how much of this material gets swept away by the river, known as the sediment flux. Previous case studies revealed that this

comes in two varieties: suspended sediment in the water column; and bedload in the form of coarse material — from gravels to boulders — rolling and bouncing along the river bottom.

“Before our work, people mostly focused on the sediment of very fine size,” said first author [Gen Li](#), an assistant professor in UC Santa Barbara’s Department of Earth Science. Measuring the flux of suspended sediment is relatively straightforward; simply collecting samples of the river water will do. It’s a routine activity conducted by government agencies.

Scientists find that suspended sediment flux increases after earthquakes. But this is only part of the picture.

It's long been known that bedload carried by rivers after earthquakes can fill up river channels with sediment. Flooding often follows earthquakes, and scientists believe that this pulse of sediment freed by a quake is to blame. The increased bedload raises the riverbed, so the river overflows from the shallower channel. Unfortunately,



Photo Credit

Li et al.

Powerful floodwaters carried landslide debris down the Min River, leaving boulders perched atop what remains of this bridge.

A small stroke of luck amid a disaster

In 2001, the Sichuan Provincial Electric Power Company began constructing the Zipingpu Dam. By 2006, the structure began to impound the Min River, which drains part of the Longmen Mountains. The reservoir is located 20 kilometers downstream of the Wenchuan Earthquake's epicenter. By mere happenstance, it became the perfect sediment trap for a team of curious geologists.

In collaboration with the Chinese Bureau of Hydrology, Li and his co-authors began surveying the sediment flowing into the reservoir. The agency monitors the suspended sediment flux each day, but the scientists would need more data to characterize the river's bedload.

This seemingly straightforward task required an enormous effort spanning over a decade of field campaigns. The team spent days on a boat mapping the bottom of the reservoir with sonar. The changes from one field expedition to the next built up an account of how much total sediment had accumulated in the reservoir over time.

It was then a simple matter to calculate the bedload flux: just subtract the suspended load flux from the total sediment flux.

Large results

The research team found that total sediment flux in the Min River grew sixfold after the Wenchuan Earthquake. However, the bedload component increased by 20 times. This meant bedload accounted for roughly 65% of the overall sediment flowing through the river after the earthquake. Values of around 20% are more typical of mountain rivers of this size.

This result wasn't particularly surprising to co-author Josh West. He had suspected that fluxes would be very high after a major earthquake, with a significant amount of bedload transport.

But the team wasn't interested only in the bedload flux. They also wanted to know how long it would take the Min River to clear the pulse of material liberated by the earthquake. The elevated flux persisted for at least ten years, up to the last field

expedition the authors took before publishing their results.

“In fact, from the data we’ve collected so far, there’s no evidence yet of the total sediment flux declining back to background levels,” said West, an Earth Sciences professor at the University of Southern California.

The findings have major implications for how we manage natural disasters. “Usually, we think the influence from earthquakes may last, at most, a few years after the main shock,” Li said. “But this data shows that this is not true.” The cascade of hazards induced by a large earthquake can persist far longer than people may expect, possibly decades.

The long tail of geohazards

Insights in this paper will help researchers and officials understand the cascade of hazards that can occur after a major earthquake. This happens when one event triggers a whole sequence that amplifies the initial danger. “Earthquake-triggered landslides are a great example,” West said.

“As we prepare for natural disasters, we often think of them as being discrete events,” he continued. Costs and actions are framed in terms of preparing for this event and dealing with its immediate aftermath. “But what’s left out of that is the longer tail that follows.”

For instance, it’s foolish to rebuild in the same way in the same place, the authors said. The risks aren’t merely as high as they were before; they’ve actually increased because the landscape has changed. A stopped-up river can’t accommodate the same 10-year flood it could have before. West’s group is continuing to investigate the cascading hazards from earthquakes and other similar events as part of a [growing group of researchers](#) working together to tackle this grand challenge.

Small clues to big questions

Understanding sediment transport after earthquakes is also crucial to answering certain fundamental questions in geology. For instance, how do earthquakes build mountains?

In theory, earthquakes uplift mountains, causing them to grow. But this paper highlights how earthquakes also erode mountains by causing landslides. So, which dominates? Like so many answers in science, that depends on the details.

In a [previous study](#), Li had measured the number of landslides caused by the Wenchuan Earthquake by painstakingly comparing satellite images of the Longmen Mountains from before and after May 2008. In that paper, he calculated that this one

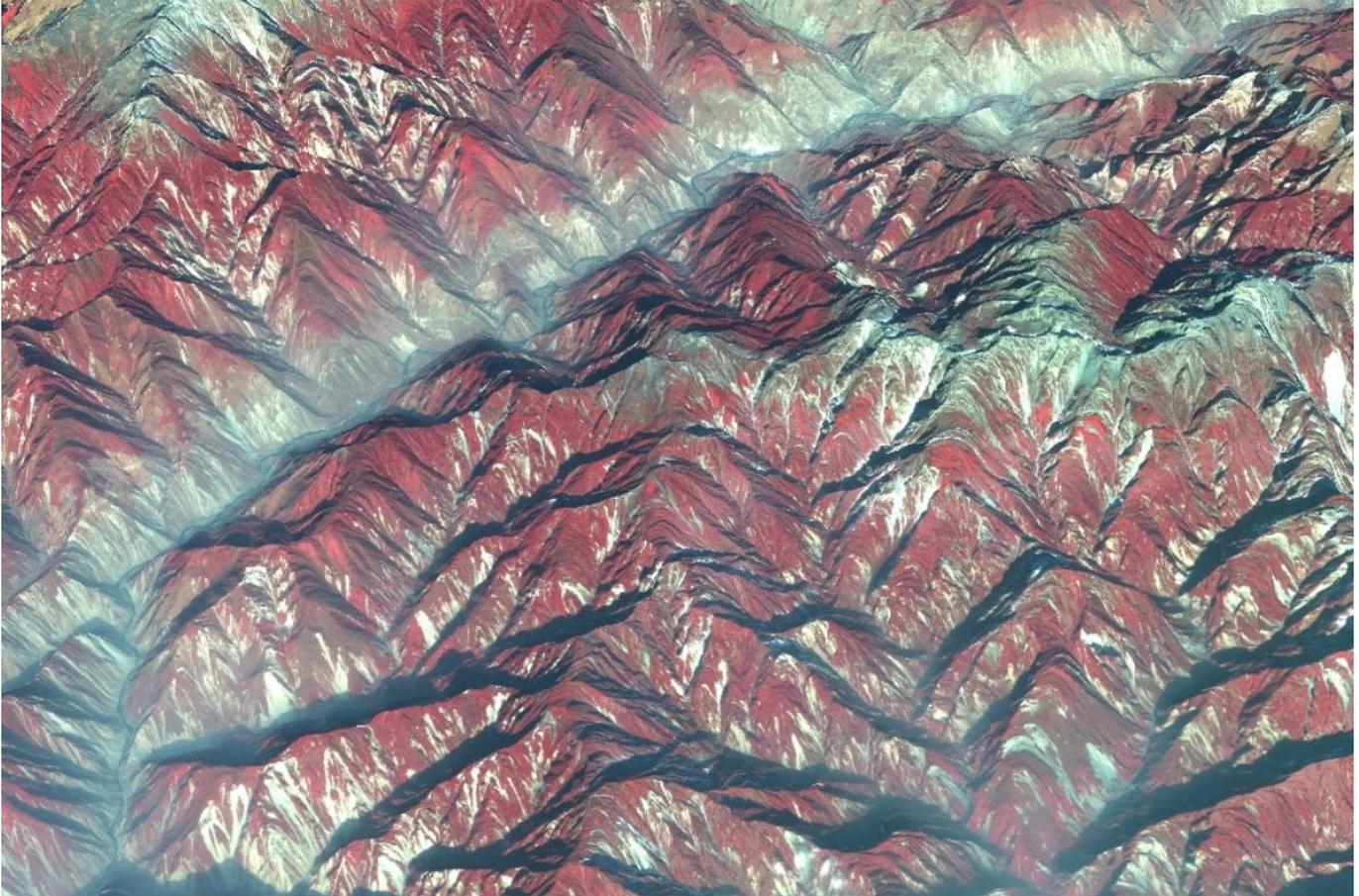


Photo Credit

Li et al.

Satellite imagery of the Longmen Mountains reveals the destruction wrought by the Wenchuan Earthquake. There's no snow depicted in this false-color composite image; all of the white patches are landslides.

In the same paper, Li used satellite observations published by scientists at the French Bureau of Geological and Mining Research to calculate the total volume rock uplifted by the Wenchuan Earthquake. He found that roughly the same amount of

material was added to the base of the mountains as eroded from its slopes. Again, scientists face the question of erosion versus uplift.

Li's previous analysis only captured the first part of the story, though. Whether a mountain grows or shrinks after an earthquake depends on how quickly its rivers can carry away the resulting landslide debris, Li explained. And their new surveys revealed that the Min River had already carried away 10% of that mass over ten years.

"The fact that the pace was sustained for ten years ... was a surprise on its own," West said. However, it's hard to extrapolate from this into the future because the watershed will evolve over the next decades, he added. The matter remains an open question.

There are many earthquakes in tectonically active mountains, so earthquake-induced landslides are a major component of erosion in these ranges. However, many factors influence the balance of uplift and erosion in mountains across the globe. Water and ice, rivers and glaciers, even plants and animals can cause erosion. The effects of earthquakes are nuanced as well. The magnitude of the quake, composition of the rock and dynamics of the watershed all affect the outcomes.

Li has begun investigating these details. He's curious why the proportion of bedload in the Min River was so high after the 2008 earthquake. The bedload isn't this high in all mountain rivers in seismically active regions, he explained. For instance, rivers in the Himalayas didn't seem to experience such a high bedload flux after the 2015 Gorkha Earthquake in Nepal.

Answering this question requires studying the composition of the landslide material itself. Details like the kind of rock a mountain is made of can make an enormous difference in the number of landslides and size of debris, how sediment is transported and how quickly it flows downstream. Li's team is working to combine data on grain size with advanced models describing how particles will behave as they travel down the watershed.

In science, answers always lead to more questions. And while the authors have their sights on solving a new set of quandaries, they're quite proud of their contributions so far. As West said, "It's very satisfying to have been able to quantify something

that we've struggled to quantify before and that has a wide range of relevance, from hazards to long-term consequences for understanding the evolution of topography over long periods of time."

Tags

[Disaster Management](#)

Media Contact

Harrison Tasoff

Science Writer

(805) 893-7220

harrisontasoff@ucsb.edu

About UC Santa Barbara

The University of California, Santa Barbara is a leading research institution that also provides a comprehensive liberal arts learning experience. Our academic community of faculty, students, and staff is characterized by a culture of interdisciplinary collaboration that is responsive to the needs of our multicultural and global society. All of this takes place within a living and learning environment like no other, as we draw inspiration from the beauty and resources of our extraordinary location at the edge of the Pacific Ocean.