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The 2004 Sumatra Earthquake Is Still Moving The Ground—600 km Away

A new study finds that land up to 600 km from the earthquake's epicentre continues to sink by a few millimetres each year.

AsianScientist (Aug. 20, 2026) – In 2004, the fault line along the west of Sumatra, Indonesia, ruptured and caused a magnitude-9.0 earthquake. The tremor was so strong that parts of Sumatra's western coastline sunk by as much as a meter. Now, a new study published in the journal *Communications Earth and Environment* has found that the layer of rock around the fault continues to move long after the earthquake.

The findings show that land as far as 600 km from the earthquake's epicenter is affected by this continuous shift, potentially sinking the ground further and speeding up sea-level rise across the region.

"When massive earthquakes strike, they do not just shake the ground for a few minutes," said lead author Dr. Grace Ng of Nanyang Technological University (NTU), Singapore. "They set off a slow adjustment deep within the Earth that can continue for years."

Although they estimate that the land only moves by a few millimetres per year, the authors say that sea-level predictions might be underestimated if ground movements like these are not considered in the forecasts.

"Most current sea-level projections focus primarily on climate factors like ice sheet melting and ocean warming," said Emma Hill, senior author and AXA-Nanyang Professor in Earth and Environmental Science at NTU. "But we must also look at how the Earth moves beneath our feet."

The study looked at almost two decades of geophysical data from stations in Singapore, Malaysia, and Thailand and analysed ground movements after major tremors such as the 2004 Sumatra earthquake and the 2012 Wharton Basin earthquake.

The team then tested the data with computer models of the Earth's layers. They discovered that a weak upper mantle beneath an active volcanic region known as the Sumatran backarc might be driving the long-distance movement.

"Our study shows that a weak layer of hot rock beneath the Sumatran backarc can slowly deform after major earthquakes," said Ng. "This helps explain why the land above can continue to shift and sink across areas hundreds of kilometres away from the earthquake."

They estimate that the layer's viscosity, or the measure of its resistance to flow, could be much lower than the global average for such types of geology, suggesting that the rocks could be flowing more easily.

Previous studies have noted that the Sumatran backarc is hotter than other subterranean locations around the world. This recent study supports the hypothesis that small-scale convection might be occurring on the weak layer, where hot rocks rise and cold rocks sink in a slow, cyclical pattern.

The results also indicate that a low viscosity might be a fundamental feature in other subduction zones worldwide, highlighting the importance of analysing GPS records for Earth movement monitoring.

"This study would not have been possible without more than a decade of continuous observations from ground-based GPS networks across the region," said Lujia Feng, co-author and Assistant Professor at NTU. "Such long-term geodetic records are vital for revealing how the solid Earth responds to great earthquakes, and how these processes evolve over time."

The team hopes that their research will be used to improve the accuracy of sea-level projection models. "Incorporating deep geological movements into our models will help us improve coastal planning for low-lying cities," Hill said.

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Source: Nanyang Technological University, Singapore ; Image: yokaew/Magnific

The study can be found at: Weak asthenosphere of Sumatran backarc revealed by long postseismic geodetic records