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Erosion may trigger earthquakes

Researchers from laboratories at Géosciences Rennes (CNRS/Université de Rennes 1)¹, Géosciences Montpellier (CNRS/Université de Montpellier 2) and Institut de Physique du Globe de Paris (CNRS/IPGP/Université Paris Diderot), in collaboration with a scientist in Taiwan, have shown that surface processes, i.e. erosion and sedimentation, may trigger shallow earthquakes (less than five kilometers deep) and favor the rupture of large deep earthquakes up to the surface. Although plate tectonics was generally thought to be the only persistent mechanism able to influence fault activity, it appears that surface processes also increase stresses on active faults, such as those in Taiwan, one of the world's most seismic regions. The work is published in *Nature Communications* on 21 November 2014.

Over the last few decades, many studies have focused on the evolution of mountain range landscapes over geological time (1 to 100 million years). The aim is to better understand the dynamics and interactions between erosion, sedimentation and tectonic deformation processes. Recent work has shown that the Earth's surface can undergo major changes in just a few days, months or years, for instance during extreme events such as typhoons or high magnitude earthquakes. Such events cause many landslides and an increase in sedimentary transport into rivers, as was the case in 2009 when typhoon Morakot struck Taiwan, leading to abrupt erosion of landscapes. Such rapid changes to the shape of the Earth's surface alter the balance of forces at the site of deep active faults.

In Taiwan, where erosion and deformation rates are among the highest in the world, the researchers showed that erosion rates of the order of 0.1 to 20 millimeters per year can cause an increase of the order of 0.1 to 10 bar in stresses on faults located nearby. Such forces are probably enough to trigger shallow earthquakes (less than five kilometers deep) or to favor the rupture of deep earthquakes up to the surface, especially if they are amplified by extreme erosion events caused by typhoons and high magnitude earthquakes. The researchers have thus shown that plate tectonics is not the only persistent mechanism able to influence the activity of seismic faults, and that surface processes such as erosion and sedimentation can increase stresses on active faults sufficiently to cause shallow earthquakes.

Thanks to an analysis of the relationships between surface processes and active deformation of the Earth in near real-time, this study provides new perspectives for understanding the mechanisms that trigger earthquakes.

¹ The Géosciences Rennes laboratory is part of the Observatoire des Sciences de l'Univers de Rennes



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Reference

Erosion influences the seismicity of active thrust faults, Steer, P., Simoes, M., Cattin, R. and Shyu, J. B. H., *Nature Communications*, 21 November 2014. DOI : 10.1038/ncomms6564.

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