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## **New study estimates the magnitudes and frequencies of the largest earthquakes on Earth.**

A fundamental question in Earth Sciences, with potential practical implications on hazard assessment, is what magnitude the largest earthquakes could reach.

New research, just presented at the European Geosciences Union General Assembly, in Vienna (Austria), provides constraints on the largest magnitudes expected for the usual (tectonic) earthquakes, and confirms that even stronger shaking may be generated by the impact of large asteroids and comets with Earth. This study is authored by Dr. Álvaro González, a researcher of the Center for Mathematical Research (CRM, Centre de Recerca Matemàtica) in Barcelona, Spain.

Giant earthquakes (with magnitude 9 or greater) are rare. Only five of them have been recorded since 1904, when reliable instrumental seismographic records started. This scarcity makes them inherently difficult to analyse, and little is known about what controls the maximum earthquake size. Such giant earthquakes are generated in subduction zones, the longest continuous faults on Earth, where a tectonic plate sinks under another. The larger a fault is, the larger the earthquakes that it can generate. The largest event on record, with magnitude 9.6, took place in Chile in 1960.

The new study evidences that **subduction zones might generate, at most, earthquakes of magnitude about 10.4. These would be the largest tectonic earthquakes on Earth, but would be extremely unlikely.** In general, this research evidences that **earthquakes with magnitude 10 or larger would be expected, at most, once every 2000 years, on average.**

Impacts of asteroids or comets with Earth cause ground shaking which can be compared to a usual earthquake. The largest recorded of these impact shaking events have been Tunguska (Siberia, 1908), with magnitude 5, and Chelyabinsk (Russia, 2013), with magnitude 3.6. Great impacts occur on long, geological timescales, and cause strong ground shaking as one of their hazardous effects.

The new study confirms that, **on human time scales, impact shaking events are much less frequent (about 10,000 times less) than normal, tectonic earthquakes** of the same magnitude. But, **on long, geological timescales (once every ten million years or more, on average) impacts shaking events may be larger than 10.4, becoming the largest possible earthquakes, even larger than the usual, tectonic earthquakes.**

These results are in agreement with formerly published modelling of impacts, and with studies which provide geological evidence of massive ground shaking due to the impact at Chixulub (Mexico) associated with the great mass extinction occurred 66 million years ago.

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