

Deepest earthquakes seem to be seasonal but we don't know why

Paul Gabrielsen, *New Scientist*, 9-24-15

Some earthquakes seem to hit in a seasonal pattern – and no one knows why.

Zhongwen Zhan of the California Institute of Technology and Peter Shearer of the Scripps Institution of Oceanography examined a global catalogue of earthquakes that have occurred since 1900. Out of 60 large, deep earthquakes in the catalogue, 42 occurred between the months of April and October.

The seasonal trend doesn't appear in shallower earthquakes or in smaller tremors, but stands out clearly for earthquakes above magnitude 7.0 and at a depth greater than 500 kilometres. An explanation remains elusive. "Physically, it doesn't make any sense," Zhan says.

It could be related to the tidal forces felt by Earth due to the sun's gravity, Zhan says, or possibly due to a wobble in Earth's rotational axis due to seasonal sloshing of water and air around the planet.

Stresses generated by either force are small compared with the daily and monthly forces exerted by the moon, Zhan says. But if it is down to solar tides then this may explain how earthquakes happen in a part of Earth where they aren't expected.

That's because at depths between 500 and 700 kilometres, the rocks are under high temperatures and pressures that should render them soft and pliable – and unlikely to suddenly rupture and cause a quake. "The high pressure makes people think there shouldn't be any earthquakes," Zhan says.

Tidal nudge

Solar tidal forces may provide the nudge needed to trigger a deep earthquake. "That means that [the earthquake] nucleation process is very sensitive to small stress perturbations," Zhan says.

As early as the 1930s, geologists claimed to have found a seasonal trend in earthquake activity. Often, as decades pass and new data comes to light, the correlations weaken, says Cliff Frohlich of the University of Texas at Austin.

Although Zhan's methods are sound the result may only be a statistical aberration, and lacks a physical mechanism, Frohlich says. "If you're searching for some possible explanation, the solar tide would be your candidate," he says. "But it's not a very strong candidate because it's not a very strong tide."

Zhan found that the seasonal trend is stronger in some regions than others. Almost all of the large, deep earthquakes near Japan fell between April and October, for example, while earthquakes near Tonga were spread more evenly through the year.

He says that it will only take a few more decades of earthquake data to see whether the seasonal trend is an actual phenomenon or just random chance. A 30 May earthquake, centred in the Bonin Islands 1000 kilometres south of Tokyo, is already a candidate for inclusion in the data set.

A confirmed trend may lead to earthquake prediction tools, Zhan says. "Studying these deep earthquakes may help us understand the earthquake nucleation process in general, therefore helping understanding large shallow earthquakes too, which are much more damaging."