New discovery could highlight areas where earthquakes are less likely to occur

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Scientists from Cardiff University have discovered specific conditions

that occur along the ocean floor where two tectonic plates are more likely to slowly creep past one another as opposed to drastically slipping and creating catastrophic earthquakes.

The team have shown that where fractures lie on the ocean floor, at the junction of two tectonic plates, sufficient water is able to enter those fractures and trigger the formation of weak minerals which in turn helps the two tectonic plates to slowly slide past one another.

The new findings, which have been published in the journal *Science Advances*, could potentially help scientists understand the size of stresses at specific fault lines and whether or not the tectonic plates could possibly trigger an earthquake.

This, in turn, could potentially contribute to solving one of the greatest challenges that faces seismologists, which is to be able to forecast earthquakes with enough precision to save lives and reduce the economic damage that is caused.

Earth's outer layer, the lithosphere, is made up tectonic plates that shift over the underlying asthenosphere like floats on a swimming pool at rates of centimeters per year.

Stresses begin to build up where these plates meet and are relieved at certain times either by earthquakes, where one plate catastrophically slips beneath the other at a rate of meters per second, or by creeping whereby the plates slip slowly past one another at a rate of centimeters per year.

Scientists have for a long time been trying to work out what causes a particular plate boundary to either creep or to produce an earthquake.

It is commonly believed that the slip of tectonic plates at the juncture of

an oceanic and continental plate is caused by a weak layer of sedimentary rock on the top of the ocean floor; however, new evidence has suggested that the rocks deeper beneath the surface in the oceanic crust could also play a part and that they may be responsible for creep as opposed to earthquakes.

In their study, the team from Cardiff University and Tsukuba University in Japan looked for geological evidence of creep in rocks along the Japan coast, specifically in rocks from oceanic crust that had been deeply buried in a subduction zone, but through uplift and erosion were now visible on the Earth's surface.

Using state-of-the-art imaging techniques the team were able to observe the microscopic structure of the rocks within the oceanic crust and use them to estimate the amount of stress that was present at the tectonic plate boundary.

Their results showed that the oceanic crust was in fact far weaker than previously assumed by scientists.

"This means that, at least in the ancient Japanese subduction zone, slow creep within weak, wet oceanic crust could allow the ocean lithosphere to slip underneath the overlying continent without earthquakes being generated," said lead-author of the study Christopher Tulley, from Cardiff University's School of Earth and Ocean Sciences.

"Our study therefore confirms that oceanic crust, typically thought to be strong and prone to deforming by earthquakes, may instead commonly deform by creep, providing it is sufficiently hydrated."

More information: Christopher J. Tulley et al. Hydrous oceanic crust hosts megathrust creep at low shear stresses, *Science Advances* (2020). DOI: 10.1126/sciadv.aba1529

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