Megathrust quake faults weaker and less stressed than thought

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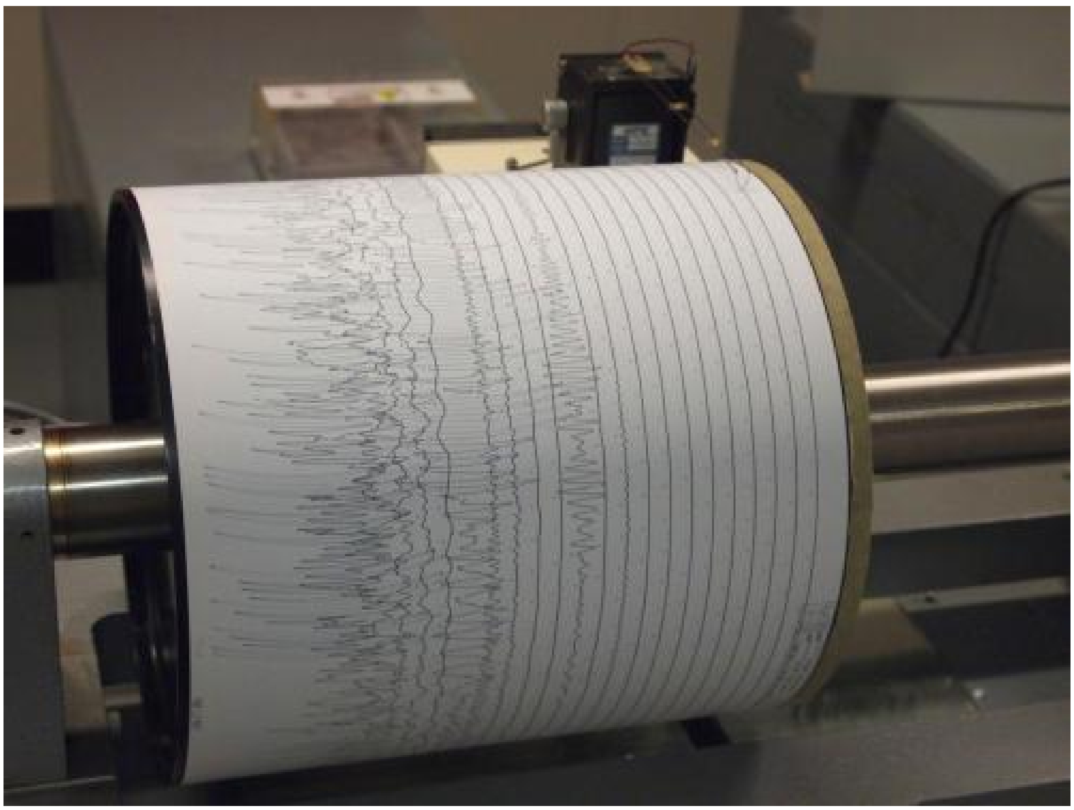

Seismogram being recorded by a seismograph at the Weston Observatory in Massachusetts, USA. Credit: Wikipedia

Some of the inner workings of Earth's subduction zones and their "megathrust" faults are revealed in a paper published today in the journal *Science*. U.S. Geological Survey scientist Jeanne Hardebeck calculated the frictional strength of subduction zone faults worldwide, and the stresses they are under. Stresses in subduction zones are found to be low, although the smaller amount of stress can still lead to a great earthquake.

Subduction zone megathrust faults produce most of the world's largest earthquakes. The stresses are the forces acting on the subduction zone fault system, and are the forces that drive the earthquakes. Understanding these forces will allow scientists to better model the physical processes of subduction zones, and the results of these physical models may give us more insight into earthquake hazards.

"Even a 'weak' fault, meaning a fault with low frictional strength, can accumulate enough stress to produce a large earthquake. It may even be easier for a weak fault to produce a large earthquake, because once an earthquake starts, there aren't as many strongly stuck patches of the fault that could stop the rupture," explained lead author and USGS geophysicist Hardebeck.

Although the physical properties of these faults are difficult to observe and measure directly, their frictional strength can be estimated indirectly by calculating the directions and relative magnitudes of the stresses that act on them. The frictional strength of a fault determines how much stress it can take before it slips, creating an earthquake.

Evaluating the orientations of thousands of smaller earthquakes surrounding the megathrust fault, Hardebeck calculated the orientation of stress, and from that inferred that all of the faults comprising the subduction zone system have similar strength. Together with prior evidence showing that some subduction zone faults are "weak", this implies that all of the faults are "weak", and that subduction zones are "low-stress" environments.

A "strong" fault has the frictional strength equivalent to an artificial fault cut in a rock sample in the laboratory. However, the stress released in earthquakes is only about one tenth of the stress that a "strong" fault should be able to withstand. A "weak" fault, in contrast, has only the strength to hold about one earthquake's worth of stress. A large earthquake on a "weak" fault releases most of the stress, and before the next large earthquake the stress is reloaded due to motion of the Earth's tectonic plates.

More information: "Stress orientations in subduction zones and the strength of subduction megathrust faults" www.sciencemag.org/lookup/doi/ … 1126/science.aac5625

Provided by United States Geological Survey

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