Systematic shifts in subducting slab behavior with depth

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When tectonic plates collide, the less buoyant plate will, in some cases, be forced beneath the other. At such subduction zones the sinking tectonic plate, known as a slab, does not follow a simple path from the surface to the deeper mantle. Instead, new research by Fukao and Obayashi suggests that subducting slabs pass through four largely distinct stages as they penetrate toward the core. To systematically catalog the stages of slab subduction, the authors analyzed roughly 10 million observations of the subsurface that were part of a tomographic study that used primary seismic waves to detect the structure of slabs in subduction zones around the Pacific.

The authors find that for a given subduction zone, subducting slab properties vary progressively along the subduction arc. Slab dynamics are broken down into four major stages with differing behavior organized around a discontinuity centered at a depth of 660 kilometers (410 miles) —the barrier between the upper and lower mantle. In some depth range down to around 660 kilometers many slabs get stuck and are temporarily prevented from penetrating deeper.

Some slabs in this stuck zone, however, penetrate right through the 660-kilometer-deep discontinuity, moving at a steep angle. From a depth of 660 to 1000 kilometers (410 to 621 miles) the slabs often get stuck once more. Some slabs make it farther down, below 1000 kilometers, where the slab is free to sink into the lower mantle.

The authors suggest that the lower stuck zone, from a depth of 660 to

1000 kilometers, serves as an important stable reservoir of slab material and may play a unique role in mantle convection processes.

More information: Subducted slabs stagnant above, penetrating through, and trapped below the 660-km discontinuity, *Journal of Geophysical Research-Solid Earth*, doi: 10.1002/2013JB010466 , 2013

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