

Subduction of oceanic asthenosphere: evidence from sub-slab seismic anisotropy

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The oceanic asthenosphere is characterized as a low viscosity channel down to 200-300km depth separating the cold lithosphere from above, and it is intimately linked to a layer of low seismic velocity and prominent seismic anisotropy observed globally beneath ocean basins. While subduction of tectonic plates in convergent margins is well recognized, the fate of oceanic asthenosphere remains enigmatic. We demonstrate that the entrainment of the oceanic asthenosphere with its inherited azimuthal anisotropy and strong radial anisotropy explains most of the sub-slab shear-wave splitting patterns, where the fast splitting direction changes from predominantly trench-parallel under relatively steep subduction zones to frequently trench-normal under shallow subduction zones. Substantial amount of oceanic asthenosphere, on the order of 100km, is likely entrained down to the deep upper mantle, which suggests that the mass flux associated with subduction as well as geochemical recycling and mixing may deserve to be revisited. The origin of the asthenospheric fabric consistent with the observation will be also discussed.