



The Atlas of the Underworld: a catalogue of slab remnants in the mantle imaged by seismic tomography, and their geological interpretation

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Seismic tomography has provided a breakthrough in the analysis of plate tectonic history by allowing to trace now-subducted, ancient lithosphere in the Earth's mantle, where they appear as large positive seismic wave-speed anomalies. Subduction also leaves a geological record that allows for dating the geological period of active subduction. By combining these sources of information, we previously compiled 28 lower-mantle slab remnants and estimated for the timing of onset and end of subduction of these slabs, from which we derived a first-order sinking rate of slabs through the mantle (van der Meer et al., 2010). This constraint on lower mantle slab sinking rates allowed for the development of the first slab mantle reference frame, and was used to constrain of mantle viscosity. Since that first compilation, the plate tectonic and seismological community has made major progress on linking geological history to mantle structure. Slabs were linked to plate tectonic models at regional scale, contributed to understanding of orogenies at local level, and was recently even used as a novel basis for plate kinematic restorations. When analyses were expanded into the Pacific realm it improved our understanding of the presence of seismic scatterers in the sub-Pacific mantle and Pacific LLSVP topography. Expanding the tomographic analysis to a global, whole-mantle scale has led to the calculation of total lateral slab lengths, which was used to calculate corresponding subduction zone lengths through time that provided constraints for plate tectonic activity over the past 235 Myr impacting atmospheric CO₂ and providing insights in the link between strontium isotope curves and global sea level. Encouraged by the direct and indirect results of our previous work, we have expanded our analysis to nearly 100 mantle images throughout the upper and lower mantle, which we correlate to 94 subduction systems active in the past ~300 Myr. We provide our geological interpretation of these slabs, linking them to geological records of subduction, from which we infer the age of subduction of the top and bottom of these slabs. This compilation is summarized in the Atlas of the Underworld, for which we also developed an online version at www.atlas-of-the-underworld.org that is fully searchable and includes discussion forums for each interpreted slab to facilitate post-publication peer review. This document is intended to provide constraints for future studies in the fields of orogenesis, mantle convection and plate tectonic reconstruction, and as a first backbone interpretation of global mantle structure that may serve as basis for future studies targeting mantle evolution.