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Abrupt and continental-wide upper-plate tilting induced by slab–transition-zone collision

Fabio Crameri (1) and Carolina Lithgow-Bertelloni (2)

(1) University of Oslo, Centre for Earth Evolution and Dynamics (CEED), Mathematics and Natural Sciences, Oslo, Norway (fabio.crameri@geo.uio.no), (2) University College London (UCL), Department of Earth Sciences, London, UK

During its sinking, the remnant of a surface plate crosses and interacts with multiple boundaries in Earth's interior. The most-prominent dynamic interaction arises at the upper-mantle transition zone where the sinking plate is strongly affected by the higher-viscosity, higher-density lower mantle. Within our numerical model, we unravel, for the first time, that this very collision of the sinking slab with the transition zone induces a sudden and continental-wide downward tilt of the upper plate towards the subduction trench.
The slab-transition zone collision sets parts of the higher-viscosity lower mantle in motion. Naturally, this then induces an overall larger return flow cell that, at its onset, tilts the upper plate abruptly by around 0.03 degrees and over around 10 Millions of years. Such a continental-wide and abrupt tilt variation of a continents surface is clearly observable in various temporal geologic records like for Australia since the Eocene or for North America during the Phanerozoic. The slab-transition zone interaction proofs to be the only viable mechanism known to date to explain all the dramatic tilt, its large spatial extent and its abruptness.
Unravelling this crucial mantle-lithosphere interaction was possible thanks to state-of-the-art numerical modelling (powered by StagYY; Tackley 2008, PEPI) and fully-automated Geodynamic diagnostics (powered by StagLab; www.fabiocrameri.ch/software).