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Preliminary numerical modelling results of induced subduction initiation: the slab vs. overriding plate thermal control on subduction polarity flip

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The problem of subduction initiation has been a cornerstone in the field of geodynamics since its inception. Despite numerous field studies (e.g. Wright and Wyld, 2011), analogue studies (e.g. Duarte et al., 2015) and modelling studies (e.g. Cloetingh, Wortel and Vlaar, 1989; Kemp and Stevenson, 1996; Stern, 2004; Nikolaeva, Gerya and Marques, 2010; Stern and Gerya, 2017), the dynamics of subduction initiation is still yet to be resolved. Our work focuses on numerical modelling investigation of 2D polarity reversal (or polarity flip). Numerical experiments were carried out using Underworld, a geodynamic particle-in-cell parallel computational framework developed at Monash University. We consider, as a general natural analogue, the prevailing geometry and kinematics that characterize the formation of the Caribbean arc.
Present day interpretation of the geodynamic evolution of the Caribbean region favours the occurrence of polarity flip during late Cretaceous due the arrival of the Colombian-Caribbean Oceanic Plateau (CCOP) to the trench between the Farallon plate and the proto-Caribbean plate (Wright and Wyld, 2011). Accordingly, gravity-driven subduction models were conceived, simulating a positively buoyant crustal plateau arriving at an ocean-ocean subduction trench, “locking” (i.e. obstructing) this subduction system.
We investigated the role the age of both overriding and subducting oceanic plates in controlling the tectonic evolution of plateau docking and its consequences on the subduction setting.
We find that for younger (i.e. more thermally active) slabs and overriding plates, the docking leads to a strong strain weakening on the trench-proximal part of the overriding plate. This leads to a sinking of this part along this newly formed interface, causing breakoff of the original slab and leading to subduction initiation.
For older (i.e. more thermally inactive and stiffer), the docking leads to plateau accretion on to the overriding plate and the eventual trench migration to the back of the plateau.
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