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Dynamics of small scale subduction systems: a numerical and analogue approach

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In this study we present the results of numerical and analogue experiments of a double subduction system characterized by two adjacent slabs retreating in opposite directions. Such a tectonic scenario has been proposed to occur in several regions of the Earth, most recently in the Westernmost Mediterranean. The basic setup consists of two oceanic plates with a linear viscous rheology descending into the upper mantle. Both plates are fixed at their trailing edge to enforce roll-back behavior during subduction driven by a Rayleigh-Taylor instability. The two retreating plates interact with each other as a result of subduction-induced mantle counter-flow. Previous laboratory experiments, based on viscous syrup (representing the mantle) and silicone putty (representing the plates), show that the mantle flow induced by both plates is asymmetrical producing variations of rollback velocities and lateral separation between plates. Additionally, a high-resolution finite difference 3D numerical model (I3ELVIS code) is carried out with the identical material parameters and geometry as for the analogue model. The combination of both experiments allows us to numerically quantify the physical parameters that characterize the evolution of the system such as trench velocities, strain rates, and stresses. We also study how boundary conditions and scaling for analogue modelling may affect the numerical results.
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