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3D Numerical simulations of oblique subduction

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In the past 2D numerical studies (e.g. Gerya et al., 2002; Gorczyk et al., 2007; Malatesta et al., 2012) provided evidence that during intraoceanic subduction a serpentinite channel forms above the downgoing plate. This channel forms as a result of hydration of the mantle wedge by uprising slab-fluids. Rocks buried at high depths are finally exhumed within this buoyant low-viscosity medium. Convergence rate in these 2D models was described by a trench-normal component of velocity.
Several present and past subduction zones worldwide are however driven by oblique convergence between the plates, where trench-normal motion of the subducting slab is coupled with trench-parallel displacement of the plates. Can the exhumation mechanism and the exhumation rates of high-pressure rocks be affected by the shear component of subduction? And how uprise of these rocks can vary along the plate margin?
We tried to address these questions performing 3D numerical models that simulate an intraoceanic oblique subduction. The models are based on thermo-mechanical equations that are solved with finite differences method and marker-in-cell techniques combined with multigrid approach (Gerya, 2010). In most of the models a narrow oceanic basin (500 km-wide) surrounded by continental margins is depicted. The basin is floored by either layered or heterogeneous oceanic lithosphere with gabbro as discrete bodies in serpentinized peridotite and a basaltic layer on the top. A weak zone in the mantle is prescribed to control the location of subduction initiation and therefore the plate margins geometry.
Finally, addition of a third dimension in the simulations allowed us to test the role of different plate margin geometries on oblique subduction dynamics. In particular in each model we modified the dip angle of the weak zone and its "lateral" geometry (e.g. continuous, segmented). We consider "continuous" weak zones either parallel or increasingly moving away from the continental margins. Moreover, we tested the effect on subduction/exhumation dynamics of several values of the trench-parallel component of convergence-rate vector.

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