Geophysical Research Abstracts
Vol. 20, EGU2018-16553, 2018
EGU General Assembly 2018

Sediment cover influences subduction dynamics and orocline formation in oceanic domain - insights from numerical modeling.

Jessica Munch (1), Kosuke Ueda (1), Dave May (2), Jean-Pierre Burg (1), and Taras Gerya (1)

(1) Department of Earth Sciences, ETH Zürich, Zürich, Switzerland (jessica.munch@erdw.ethz.ch), (2) Department of Earth Sciences, University of Oxford, U.K

The formation of oroclines (large scale curved topographic features located above the subduction zone) remains a poorly understood process associated with retreating subduction, which is an important mechanism of plate tectonics on Earth and can be observed in various places such as the Caribbean or the Scotia subduction zone.

One important consideration in subduction dynamics is the role of subducted sediments. Although thin sediment covers are volumetrically a very minor part of a subducting plate, they could have considerable leverage. Subducted, fluid-rich sediments potentially facilitate magma generation in the mantle and could lubricate the subduction zone. Sediment accumulation in the trench (accretionary wedge) could modulate subduction angle and slow down or block slab retreat. In this study, we test the influence of the sediment cover on subduction dynamics and specifically orocline formation.

We employ high-resolution 3D numerical simulations of narrow retreating subduction zones in an oceanic domain using the viscoplastic thermomechanical code I3ELVIS (Gerya and Yuen, 2007) coupled to a new surface process code. The latter allows for self-consistent material diffusion and advection. We initiate spontaneous subduction retreat by prescribing a laterally limited region of young and weak oceanic lithosphere with strong age contrast with the surrounding older and stronger plate. We vary the initial sedimentary cover thickness on the oceanic floor. Models are analyzed in terms of topography development above the subduction zone with attention to the influence of incoming sediments on slab retreat dynamics.
Results shows that a sediment cover of the subducting plate strongly influences the subduction evolution as well as the orocline morphology. Slab retreat is slower with a 4 km thick sedimentary cover than with no sedimentary cover. The presence of sediments considerably reduces topography, especially in the trench where an accretionary prism forms. Sediments also influence strain patterns at the surface.
After 3 Ma of slab retreat, we observe a curved trench for both simulations. However, the smoothing effect of sediments, which may be mechanically buffered in the accretionary wedge, is also seen laterally, and the curvature is stronger in the simulation with no sedimentary cover.

Reference:
Gerya, T. V., & Yuen, D. A. (2007). Robust characteristics method for modelling multiphase visco-elasto-plastic thermo-mechanical problems. Physics of the Earth and Planetary Interiors, 163(1), 83-105.