Numerical modelling of the plate retreat at the Hellenic Subduction Zone

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Abstract
Subduction is a tectonic process, where one tectonic plate of oceanic lithosphere moves under another tectonic plate of usually continental lithosphere and sinks into Earth's mantle. A subduction zone is the area, where subduction takes place and is characterised by deformation. As the oceanic plate subducts an arcuate trench is shaped between the two plates. The deformation of the upper plate is either tensional or compressive.
Regarding the Mediterranean region the deformation was mainly controlled by slab retreat for the last 30-35 Ma [1]. Slab retreat means, that the subducting slab migrates away from the upper plate and not towards it. The trench at the Hellenic Subduction Zone is strongly curved and the upper plate is stretched at the Aegean.
With the intention to do a three-dimensional finite element model for reproducing the deformation of this region first a two-dimensional plane strain finite element model is set up as a start for this. Mainly this is done to get a first information about the conditions for slab retreat by a simple model and by avoiding the computational effort related to the three-dimensionality. The two-dimensional model includes a plane strain box with a portion of mantle, the two interacting plates and a top light weak layer representing air or water. An initial dip for the subducting plate is assessed. All boundaries except the top one are free-slip boundaries, the top boundary is free. The applied load is gravity load, no velocities are imposed. A Maxwell-viscoelastic incompressible material is chosen with varying relaxation times for the different layers. For this setup the advance of the plate retreat is monitored. The information of the two-dimensional models is then included in the three-dimensional model.

Reference
[1] Jolivet L., Faccena C., Piromallo C., 2009. From mantle to crust: Stretching the Mediterranean. Earth and Planetary Science Letters 285, 198-209.