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Influence of paired subduction zones: insight into Central Mediterranean tectonics

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The Hellenic and Calabrian slabs are subducting the last remnant of the Ionian oceanic lithosphere into the deep mantle beneath the Central Mediterranean. Seismic tomography studies have provided clear images of the present day morphology of the subducted lithosphere [1]. Tectonic studies have shown that the Calabrian slab has rolled back into its current geometry with episodes of back-arc spreading that have now ceased [2]. Conversely, GPS observations along with tectonic reconstructions show that the Hellenic slab is currently rolling back and appears to have accelerated in the past $\sim$15 My [3], which has resulted in the only region of backarc spreading still active in the Mediterranean. Observations of seismic anisotropy from SKS splitting [4] indicate toroidal flow patterns at the edges of the subducted slabs, which lead to interpretations of mantle convection and flow.

Rollback in a confined setting has allowed the two slabs to become a plate-tectonic pushmi-pullyu [5]. The evolution of each slab is necessarily dependent on the other as they are both subducting the same lithosphere in opposite directions and are sufficiently close together that their induced mantle flow patterns must interact strongly. Although this seems to be an oddity in the classical picture of plate tectonics, we note that rollback-dominated subduction is more likely to be important in the highly-confined setting of a closing ocean where the oceanic lithosphere is not always able to develop into a freely-moving plate. Under such conditions, back-to-back pairings of subducting slabs are potentially more common.

To investigate this setting, we present preliminary numerical models of paired subduction zones that we have developed using Underworld. We include variations in the strength and buoyancy of the surrounding (over-riding) plates and account for the presence of continentally-derived basement in the Adriatic sea. The geodynamic models allow for exploration into the timing, mechanics, and evolution of the last remnant of the oldest oceanic lithosphere on Earth being consumed due to the convergence of Africa and Eurasia.

References:

[1] Piromallo & Morelli, 2004; Lucente et al, 1999
[2] D'Agostino & Selvaggi, 2004; Serpelloni et al., 2007
[3] Royden & Husson 2006
[4] Civello & Margheriti, 2004; Evangelidis et al, 2011
[5] Lofting, 1920