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The influence of overriding plate and trench motion in subduction process: Insights from numerical models

Valentina Magni (1), Jeroen van Hunen (2), Francesca Funiciello (1), and Claudio Faccenna (1)

(1) Università di Roma Tre, Dipartimento di Scienze Geologiche, Roma, Italy, (2) Durham Universiy, Department of Earth Sciences, Durham, UK (vmagni@uniroma3.it)

The intimate role between plate and trench motions and the dynamics of the subducting slab have previously been extensively studied by numerical and analogue modeling of a subducting plate in the absence of an overriding plate. These studies have illustrated that the subduction mode (retreating Vs advancing) strictly depends on the viscosity contrast between the lithosphere and the upper mantle. Due to the nature of these models, the role of temperature-dependent viscosity and significance of a thermo-mechanical overriding plate could not be examined. This study aims to examine these influences with improved numerical models.
To that end, we developed 2D and 3D numerical temperature-dependent models to study the role of the overriding plate in subduction process. Our thermal models include both an upper and lower mantle, a subducting slab and an overriding plate. This setup will enable us to examine the influence of the overriding plate in the whole subduction process. We performed model calculations where the trench and the overriding plate are free to move. We first show systematic tests of the effects of 1) the weak zone characteristics, 2) the viscosity structure of the model and 3) the plate age and density on the geometry, kinematics and dynamics of subduction. Next we show how the models presented here can be used to test the role of the overriding plate in different types of convergent margins. Numerical results will be compared with natural data from updated global databases.