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3D Numerical modelling of topography development associated with curved subduction zones

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Curved subduction zones, also called oroclines, are geological features found in various places on Earth. They occur in diverse geodynamic settings: 1) single slab subduction in oceanic domain (e.g. Sandwich trench in the Southern Atlantic); 2) single slab subduction in continental domain, (e.g. Gibraltar-Alboran orocline in the Western Mediterranean) 3); multi-slab subduction (e.g. Caribbean orocline in the South-East of the Gulf of Mexico). These systems present various curvatures, lengths (few hundreds to thousands of km) and ages (less than 35 Ma for Gibraltar Alboran orocline, up to 100 Ma for the Caribbean). Recent studies suggested that the formation of curved subduction systems depends on slab properties (age, length, etc) and may be linked with processes such as retreating subduction and delamination. Plume induced subduction initiation has been proposed for the Caribbean. All of these processes involve deep mechanisms such as mantle and slab dynamics. However, subduction zones always generate topography (trenches, uplifts, etc), which is likely to be influenced by surface processes. Hence, surface processes may also influence the evolution of subduction zones.

We focus on different kinds of subduction systems initiated by plume-lithosphere interactions (single slab subduction/multi-slab subduction) and scrutinize their surface expression. We use numerical modeling to examine large-scale subduction initiation and three-dimensional slab retreat. We perform two kinds of simulations: 1) large scale subduction initiation with the 3D-thermomechanical code I3ELVIS (Gerya and Yuen, 2007) in an oceanic domain and 2) large scale subduction initiation in oceanic domain using I3ELVIS coupled with a robust new surface processes model (SPM). One to several retreating slabs form in the absence of surface processes, when the conditions for subduction initiation are reached (c.f. Gerya et al., 2015), and ridges occur in the middle of the extensional domain opened by slab retreat. Topography associated with slab retreat is curved. Coupling I3ELVIS with SPM yields more accurate topography of the curved subduction zone. This allows balancing the relative importance of surface and deep processes in the evolution of curved subduction zones and the development of their related topography.

References:
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.
Gerya, T. V., Stern, R. J., Baes, M., Sobolev, S. V., & Whattam, S. A. (2015). Plate tectonics on the Earth triggered by plume-induced subduction initiation. Nature, 527(7577), 221-225.