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Impact of deep subduction processes on surface topography.

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How surface topography relates to subduction zones remains enigmatic due to the poorly understood interaction between the surface and deep slabs. To first-order, seismic tomography shows that slab morphology varies from sinking straight into the lower mantle to lying flat into transition zone above ∼670 km depth. These differences might be the footprints of the past subduction zones histories, and along with these subduction dynamics evolutions, vertical displacement of the continents close to the trench occurred.
A large number of numerical and analogue subduction models have been proposed to constrain subduction dynamics by exploring the role of minerals changes, mantle and lithosphere rheologies, and/or plate kinematics. However, most of these previous studies did not take into account how these deep processes might generate large-scale topographic variations of the overriding plate throughout subduction evolution.
With the aim to overcome this limitation and we carry out 2D self-consistent subducting numerical simulations using the numerical code Citcom in order to understand the surface evolution of subduction zones through times. Our simulations cover a plausible range of mantle viscosity profiles and Clapeyron slopes for the olivine mineral transitions and reproduce both slabs laying down at the transition zone and sinking straight into the lower mantle. Our results show that the uplift of the overriding plate occurs when the slab sinks without trench retreat or when the slab tends to sink straight into the lower mantle. In contrast, subsidence of the overriding plate happens when the slab lies down in the transition zone along with a high trench retreat motion. The most remarkable topographic variations occur when the slab is buckling in the transition zone, when trench retreat and advance happen.
These numerical results might be correlated with abrupt subsidence and uplift patterns that have been recorded on the continental part, even far from the trench due to the interactions between slabs, transition zone and deep mantle.