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Relationships between deformation and morphology of forearc wedges and earthquake ruptures

Nadaya Cubas
Sorbonne Université, ISTEP, paris, France (nadaya.cubas@upmc.fr)

Over the last decade, we have accumulated evidence that, along subduction zones, a significant part of the seismic cycle deformation is permanently acquired by the medium and reflects the variation of rupture properties along the megathrust. Assuming a persistence of the megathrust segmentation over several hundred thousand years, this permanent deformation and the forearc topography could thus reveal the mechanics of the megathrust. Numerous recent studies have also shown that the megathrust effective friction appears to differ significantly between aseismic or seismic areas. From mechanical modelling, I will first discuss how such differences in effective friction are significant enough to induce wedge segments with varying morphologies and deformation patterns. I will present examples from different subduction zones characterized by either erosive or accretionary wedges, and by different seismic behaviors. Secondly, I will present how this long-lived deformation can in turn control earthquake ruptures. I will show, that along the Chilean subduction zone, all recent mega-earthquakes are surrounded by basal erosion and underplating. Therefore, the deformation and morphology of forearcs would both be partly linked to the megathrust rupture properties and should be used in a more systematic manner to improve earthquake rupture prediction.