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Relative Importance of Trenchward Upper Plate Motion and Friction Along the Plate Interface for the Topographic Evolution of Subduction-Related Mountain Belts

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We present finite-element models that investigate the relative importance of both trenchward motion of the upper plate and interplate coupling for the development of topography at convergent margins. Commonly, the role of a trenchward moving continental plate for the growth of topography is neglected in both modelling and field studies. Instead, forces exerted by the downgoing plate on the continental plate as well as interplate coupling are thought to be responsible for the deformation of the upper plate. Our model setup includes an oceanic plate, which is in contact with a continental plate along a frictional plate interface and driven by slab pull. Both lithospheres have an elasto-visco-plastic rheology. The models demonstrate that friction along the plate interface can only lead to a high topography if the upper plate is moving toward the trench. Without such a trenchward advance, no high topography is generated, as the upper plate subsides owing to the drag exerted by the subducting plate. Increasing the coefficient of friction only amplifies the drag and increases the amount of subsidence. Our findings imply that trenchward motion of the continental plate plays a key role for the development of mountain belts at convergent margins; subduction of an oceanic plate even with high interplate coupling cannot explain the formation of Andean-type orogens.