Geophysical Research Abstracts
Vol. 18, EGU2016-4113, 2016
EGU General Assembly 2016

Influence of Subducting Plate Geometry on Upper Plate Deformation at Orogen Syntaxes: A Thermomechanical Modeling Approach

Matthias Nettesheim (1), Todd Ehlers (1), and David Whipp (2)

(1) University of Tübingen, Tübingen, Germany (matthias.nettesheim@uni-tuebingen.de), (2) University of Helsinki, Helsinki, Finland

Syntaxes are short, convex bends in the otherwise slightly concave plate boundaries of subduction zones. These regions are of scientific interest because some syntaxes (e.g., the Himalaya or St. Elias region in Alaska) exhibit exceptionally rapid, focused rock uplift. These areas have led to a hypothesized connection between erosional and tectonic processes (top-down control), but have so far neglected the unique 3D geometry of the subducting plates at these locations. In this study, we contribute to this discussion by exploring the idea that subduction geometry may be sufficient to trigger focused tectonic uplift in the overriding plate (a bottom-up control).
For this, we use a fully coupled 3D thermomechanical model that includes thermochronometric age prediction. The downgoing plate is approximated as spherical indenter of high rigidity, whereas both viscous and visco-plastic material properties are used to model deformation in the overriding plate. We also consider the influence of the curvature of the subduction zone and the ratio of subduction velocity to subduction zone advance. We evaluate these models with respect to their effect on the upper plate exhumation rates and localization.
Results indicate that increasing curvature of the indenter and a stronger upper crust lead to more focused tectonic uplift, whereas slab advance causes the uplift focus to migrate and thus may hinder the emergence of a positive feedback.