Geophysical Research Abstracts
Vol. 19, EGU2017-12680, 2017
EGU General Assembly 2017

Seamount subduction underneath an accretionary wedge: modelling mass wasting and wedge collapse

Utsav Mannu (1), Kosuke Ueda (2), Sean Willett (1), Taras Gerya (2), and Michael Strasser (3)

(1) Geological Institute, ETH Zürich, 8092 Zürich, Switzerland, (2) Institute of Geophysics, ETH Zürich, 8092 Zürich, Switzerland, (3) Institute of Geology, University of Innsbruck, A-6020 Innsbruck, Austria

Seamounts (h >1 km) and knolls (h = 500 m-1000 m) cover about one-fifth of the total ocean floor area. These topographical highs of the ocean floor eventually get subducted. Subduction of these topographical features leads to severe deformation of the overriding plate and can cause extensive tectonic erosion and mass wasting of the frontal prism, which can ultimately cause a forearc wedge collapse. Large submarine landslides and the corresponding wedge collapse have previously been reported, for instance, in the northern part of the Hikurangi margin where the landslide is known as the giant Ruatoria debris avalanche, and have also been frequently reported in several seismic sections along the Costa Rica margin. Size and frequency relation of landslides suggest that the average size of submarine landslides in margins with rough subducting plates tends to be larger. However, this observation has not yet been tested or explained by physical models.
In numerical subduction models, landslides take place, if at all, on a much larger timescale (in the order of 104-105 years, depending on the time steps of the model) than in natural cases. On the other hand, numerical models simulating mass wasting events such as avalanches and submarine landslides, typically model single events at a much smaller spatio-temporal domain, and do not consider long-term occurrence patterns of freely forming landslides. In this contribution, we present a multi-scale nested numerical approach to emulate short-term landslides within long-term progressive subduction. The numerical approach dynamically produces instantaneous submarine landslides and the resulting debris flow in the spatially and temporally refined inner model. Then we apply these convoluted changes in topography (e.g. due to the submarine landslide etc.) back to an outer larger-scale model instance that addresses wedge evolution. We use this approach to study the evolution of the accretionary wedge during seamount subduction.