Discrete element simulation of faulting in a subduction zone

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The stress field, fault pattern, and earthquake distribution in an accretionary prism are linked to the topography and geometry of the subducting slab. The influence of underthrust Seamounts, in particular, is now well documented. However, the faulting mechanisms driven by the slab geometry are still incompletely understood. Here, we simulate the effects of slab interface geometry (i.e., smoothness, bending, and subduction angle) on the deformation of the accretionary wedge using the Discrete Element Method (DEM), a technique now proven to be reliable in modelling dense granular flow, rock deformation, fault propagation and folding. We explore how faulting and deformation are related to slab geometry along the Sumatran section of the Sunda megathrust. We validate the credibility of our model by comparing the results with GPS measurements from the Sumatran Tectonic Geodesy Array (SuGAr) on the forearc islands, the Sumatra fault Monitoring network (SuMo) on Sumatra Island and geophysics expedition from the Mentawai Gap - Tsunami Earthquake Risk Assessment project (MEGA-TERA). Spatial patterns of seismic distribution and mechanisms are compared to predictions from our physically-based model. Most of the earthquakes appear to take place near subducting seamounts. Such earthquakes may contribute to seismic hazard along segments of the subducting plate.

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