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Deformation patterns in accretionary wedges caused by seamounts: 3D numerical modelling

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Large areas of subducting oceanic plates obtain a rough topography due to the occurrence of submarine seamounts. At subduction zones, such seamounts often leave traces of destruction within the upper plate accretionary wedges, causing strong variations in wedge morphology and stress distribution. Resulting normal faults lowering surface tapers towards a critical wedge slope can trigger large submarine gravity flows.

We present new insight into the mechanical and dynamic consequences of seamount collision into accretionary wedges with already developed imbricate thrust sheets by using numerical modelling tools. Large-scale 3D mechanical models (100 * 100 * 15 km; 9 million nodes; 36 million markers) based on finite difference, marker-in-cell technique, are applied to test how incoming seamounts connected to the lower plate change the stress regime in accrectionary wedges and specifically how they control the surface topography of accretionary wedges during collision. We introduced different sizes for seamounts, which are either peaked or flat-topped. Furthermore, different seamount rheologies are tested.

Preliminary results show that larger seamounts (peak or plateau elevation at least equal to stratigraphic thickness) lead to increased stresses between the seamount and the backstop. The deformation front of accretionary wedges is curved and dragged towards the rear by the seamount until it is overthrusted by the imbricate thrust sheets. During seamount collision, main thrusts verging towards the wedge toe are observed along the seamount slope leading to strong uplift of the according thrust sheet. This increased uplift consequently triggers surface slope instabilities and redistributions related to gravitational collapses above the seamount towards the wedge toe.