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Short- and long-term mass transfer of subduction channels in fore-arc wedges - A comparison of scaled sandbox experiments with geophysical data

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This study focuses on the thin material transport zone between the upper and lower plates of subduction zones (subduction channel). We investigate the impact of various mass-transfer modes and flow patterns within subduction channels on the internal architecture of fore-arc wedges and on their vertical surface movement. With a series of scaled sandbox experiments, we simulated the mass-flux patterns with emphasis on the brittle part of subduction channels. Especially, we compare the short-term (refers to 10^3-10^4 years in nature) and the long-term (refers to 10^6-10^7 years in nature) mass flux.

The short-term material flux and the localisation of deformation reveal a complex temporal and spatial variability in the active mass-transfer processes within the subduction channel. The short-term material flux is particularly influenced by the activity of fore-arc structures (e.g. reactivation of backthrusts or duplexes). Only the long-term material flux exhibited diagnostic patterns for the location of sediment accretion and subduction erosion.

We show that the differences between analogue experiments simulating sediment accretion and subduction erosion in subduction channels can be applied to distinguish these end-member types in nature. The reflection seismic profiles and the seismological data of the accretive south-central Chilean fore-arc (37°-38°S) and the north Chilean fore-arc (21°-24°S), which has been a site subduction erosion since the Jurassic, only reveal the geometry of the currently active subduction channel. Nevertheless, the analogue experiments and along strike variations in nature imply that subduction channels in nature could have a complex particle-velocity pattern with a strong temporal and spatial variability.