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A Slump in the Trench: Tracking the impact of the 2011 Tohoku-Oki earthquake

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Subduction earthquakes can rupture the seafloor and trigger submarine slumps, which are potentially tsunamigenic and may affect the structural evolution of convergent plate boundaries. Bathymetric and seismic data in the Japan Trench, obtained before and after the 2011, Magnitude 9 Tohoku-oki earthquake off Japan, document significant changes proposed as seafloor- and subseafloor expressions of the tectonic and geomorphic processes associated with this mega-earthquake. One challenge groundtruthing geophysical data and models, however, is to access sea- and subseafloor samples, which can be dated to assign the hypothesized process to a given earthquake. Here we present multibeam bathymetry, reflection seismic, sediment core and pore-water geochemistry data from the Japan Trench, collected after the 2011 Tohoku-Oki earthquake. Analyzing the diffusive re-equilibration of disturbed SO42- profiles over time allows us to constrain that the observed sediment disturbance and mass movements, which link to bathymetric and structural changes observed in geophysical datasets, were indeed triggered by the 2011 earthquake. We conclude that a slump in the trench significantly impacted the geometry and evolution of the shallow plate boundary system by emerging a submarine fold-and-thrust belt and abruptly narrowing the trench up to 3 km in width.