EGU2020-7608
EGU General Assembly 2020

Evolution of tear faults in subduction zones: an analogue modelling perspective

Nicolò Bertone[1], Lorenzo Bonini[1,2], Roberto Basili[2], Anna Del Ben[1], Francesco Emanuele Maesano[2], Mara Monica Tiberti[2], and Gian Andrea Pini[1]

[1]University of Trieste, Department of Mathematics and Geosciences, Italy (nicolo.bertone@phd.units.it)

[2]Istituto Nazionale di Geofisica e Vulcanologia (INGV), Rome, Italy

Tear faults are common structures in subduction zones, especially at slab edges, where they origin from differential forces applied to a subducting slab in areas close to the trench. Presence and geometry of tears have been sometimes inferred from bathymetric features, suggesting the abrupt lateral termination of the subduction zone.

Differential forces acting at the subduction boundaries can be related to different mechanisms, such as slab retreat, differential velocities along plate margins, complex mantle flow, differential lateral rheology. As a result, plates down-warp and tear in a scissor-like motion, with both strike-slip and dip-slip kinematics.

The goal of this work is to gain insights into the evolution of tear faults by adopting an analogue modelling approach and comparing the results with natural cases. In particular, we focus on the bathymetric observation made in subduction zones where the upper plate accretionary wedge is not well developed. Two scenarios were considered: 1) tear faults nucleating and evolving in a homogeneous setting, i.e. without large mechanical discontinuities (e.g., Tonga subduction zone); and 2) tear faults reactivating pre-existing strike-slip faults as an analogue of transform faults (e.g., South Sandwich subduction zone).

The experimental apparatus was designed to reproduce the lateral propagation of a tear fault using two blocks: one entirely flat and the other with an inclined plane. Wet kaolin acts as the analogue of the intact rocks above a propagating tear fault.

Our results revealed different evolutionary processes: in the homogeneous setting, the tear fault generates a symmetric subsidence zone with an axis perpendicular to the fault zone and a depocenter located in the centre; in the second case, the depocenter is located in front of the fault plane and the subsidence zone is asymmetric. Both cases depict a symmetrical Gaussian shape of the displacement profile, with the maximum displacement located at the centre of the fault. However, the maximum slip (D_{max}) and the fault length (L) are both larger in the experiment involving a strong re-activation of the strike-slip fault than those in the case of the homogeneous setting.