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Deformation of the Calabrian Arc subduction complex and its relation to STEP activity at depth.

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Propagating tear faults at the edge of subducted slabs (“Subduction transform edge propagator”, STEP) are an intrinsic part of lithospheric plate dynamics. The surface expression of a STEP is generally not known yet, and is expected to vary significantly from one region to the other. We choose the Sicily –Calabria-Ionian Sea region, of which the lithosphere-upper mantle structure has the characteristics of a STEP zone, as a study area. The area has a very prominent accretionary wedge, the formation and subsequent deformation of which presumably were affected by the STEP activity at depth.

In this contribution, we use seismic data on the near surface structure and deformation in combination with numerical model results to investigate the relation between deep STEP activity and near surface expression. Prominent features in the surface tectonics are the Malta escarpment (with predominantly normal faulting), the newly identified Ionian Fault and Alfeo-Etna fault system, and a distinct longitudinal division of the wedge into a western and an eastern lobe (Polonia et al., Tectonics, 2011). The two lobes are characterized by different structural style, deformation rates and basal detachment depths. Numerical model results indicate that the regional lithospheric structure, such as the orientation of the eastern passive (albeit subsequently activated) margin of Sicily relative to the Calabrian subduction zone, has a profound effect on possible fault activity along the Malta escarpment. Fault activity along the above primary fault structures may have varied in time, implying the possibility of intermittent activity.

Interpreting seismicity in the context of a possible STEP, and the accompanying deformation zone at or near the surface, is not (yet) straightforward. Although direct evidence for recognizing all aspects of STEP activity is - as usual - lacking, a comparison with two well-known STEP regions, the northern part of the Tonga subduction zone and southern part of the Lesser Antilles zone (near Trinidad), leads us to conclude that aspects of the regional seismicity in the Ionian realm are in support of STEP activity in the basement underlying the accretionary wedge, near the northern part of the Ionian Fault zone.

Rather than attempting to identify one of the above faults as the present surface trace of the STEP at depth, we propose to consider the deformation zone in the Ionian Sea region as the time-varying surface expression of the STEP at the southern edge of the Calabrian slab. The present-day very limited activity along the Malta escarpment fits in this view. From the nature of the regional deformation process, we conclude that the region hosts a continuously changing segment of the plate boundary between the Eurasian and African (Nubian) plate.