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Upper-plate structural controls on the segmentation of the Kefalonia Fault (Ionian Sea, Greece)

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The NNE-SSW, right-lateral Kefalonia Transform Fault (KTF) marks the western termination of the subducting Hellenic slab, which is a part of the oceanic remnant of the African plate. The inception of the KTF, described as a STEP fault, is placed in the Pliocene. KTF is considered to be the most active earthquake source in the Eastern Mediterranean. During the last two decades, four significant earthquakes ($M > 6.0$) have been associated with the KTF. These events are attributed to the reactivation of different segments of the KTF, which are (from North to South) the North Lefkada, South Lefkada, Fiskardo, Paliki and Zakynthos segments: the North Lefkada segment ruptured in the 2003 earthquake, the 2014 Kefalonia events are associated with the Paliki segment and the 2015 Lefkada earthquake with the South Lefkada (and possibly the Fiskardo) segments.

The upper plate structure in the islands of Lefkada and Kefalonia is characterized by the Ionian Unit, thrust over the Paxi (or Pre-Apulia) Unit. The Ionian Thrust, which brings the Ionian over the Paxi Unit, is a main upper-plate NNW-SSE, NE-dipping structure. It runs through the island of Lefkada, to be mapped onshore again at the western coast of Ithaki and at SE Kefalonia. Two other major thrusts are mapped on this island: the Aenos thrust, which has a WNW-ESE strike at the southern part of the island and gradually curves towards NNW-SSE in the west and the Kalo Fault in the northern part. These Pliocene (and still active) structures developed during the late-most stages of thrusting in the Hellenides, strike obliquely to the KTF and appear to abut against it.

We suggest that these thrusts control not only the deformation within the upper plate, but also the earthquake segmentation of the KTF. This suggestion is corroborated by the spatio-temporal distribution and source parameters of the recent, well-documented earthquake events and by the macroseismic effects of these earthquakes. The abutment of the Ionian thrust against the KTF marks the southern termination of the Lefkada earthquake segment, which ruptured in the 2003 earthquake, while the Aenos, (or the Kalo) thrust mark the southern end of the Fiskardo segment. The spatial distribution of the Earthquake Environmental Effects related to the four significant events in the last 20 years displays a good correlation with our interpretation: most of the 2003 macroseismic effects are located in the northern part of Lefkada, which belongs to the upper block of the Ionian thrust; similarly, the effects of the 2014 earthquakes of Kefalonia are distributed mainly in the Paliki Peninsula and the southern part of the island that belong to the footwall of the Aenos thrust and the 2015 effects are found in SW Lefkada, which is part of the footwall of the

Ionian thrust.

We suggest that correlation between upper-plate structure and plate boundary faulting can provide insights in the understanding of faulting pattern in convergent settings, therefore contributing to earthquake management plans.