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Unravelling the competing influence of regional uplift and active normal faulting in SW Calabria, Italy

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The Neogene geological and geomorphological evolution of Southern Italy is complex and is fundamentally controlled by the subduction of the Ionian slab along the Apennine belt from the Calabrian Arc, and back-arc extension driven by trench rollback. In the area of Calabria and the Straits of Messina the presence of (i) uplifted, deformed and dissected basin sediments and marine terraces, ranging in age from the early to mid-Pleistocene and (ii) seismicity associated with NE-SW normal faults that have well-developed footwall topography and triangular facets have led workers to suggest that both significant regional uplift and extensional faulting in SW Calabria have played a role in generating relief in the area since the mid Pleistocene. However, there is considerable uncertainty in the rates of total surface uplift relative to sea level in both time and space, and the relative partitioning of this uplift between a mantle-driven regional signal, potentially related to a slab tear, and the active extensional structures.

Additionally, despite the widespread recognition of normal faults in Calabria to which historical earthquakes are often linked, there is much less agreement on (i) which ones are active and for what length of time; (ii) how the faults interact; and (iii) what their throw and throw rates are. In particular, the ability to resolve both regional uplift and normal faulting in SW Calabria is essential in order to fully understand the tectonic history of the region, while an understanding of location and slip rate of active faults, in an area where the population numbers more than two million people, is essential to assess regional seismic hazards.

Here we address these important questions using a combination of tectonic geomorphology and structural geology. We critically examine existing constraints on the rates and distribution of active normal faulting and regional uplift in the area, and we derive new constraints on the along-strike variation in throw and throw rates of normal faults from DEM analysis, geologic cross-sections and topographic swath profiles We analyse the relative magnitude of active faulting compared to the regional signal by comparing topographic profiles near the Messina Straits with those near the Ionian coast and we address the how these two deformation styles are recorded in the landscape using channel long profiles, catchment steepness and hillslope gradient metrics. Our results provide new insights into the tectonic history of Southern Italy, the seismic potential of the normal faults, and the coupled erosional-depositional evolution of Neogene basins in the area.