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Along-strike growth of a crustal fault controls the modern Corinth Rift

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The Corinth Rift is the worldwide fastest-extending subaerially-exposed continental region, and thus an outstanding natural laboratory for research on fault and young rift mechanics. Here we address two of the rift's most foundational and discrepant questions: whether the Corinth Rift formed; (i) as a "long" lived feature (∼5 Ma) by basinward fault migration, or as a short-lived feature (<1 Ma) by a single fault system; and by (ii) a north-dipping low angle detachment fault in the upper-to-middle crust or a steep normal fault affecting the entire crust. We reassess available data and integrate it into a new map of the rift and use DEM-based analysis together with key concepts of fault mechanics and fluvial geomorphology to unravel the evolution of the master fault from onset to present. Footwall relief denotes that the master fault, composed at the surface of several segments, is at depth a single fault system >90 km in length. This finding implies that the Corinth Rift master fault reaches at least basal crustal depths. This crustal master fault initiated around the present rift centre and grew laterally by linkage and inclusion of younger individual fault segments along strike and has very high slip (and derived uplift) rates all along its strike. We argue that the modern Corinth Rift results entirely from the growth of this laterally propagating rift-forming crustal fault that superimposed onto comparatively minor antecedent (∼4 My) distributed extension. These observations are at odds with Corinth Rift growth models of protracted extension and parallel basinwards-migrating faults linked or not with a shallow detachment at depth. Conversely, our results support the hypothesis of rift growth by lateral along-strike addition of fault segments triggered by a recent shift in plate boundary conditions <1 Ma, an evolution compatible with the southwestwards propagation of the tip of the North Anatolian Fault.