Are abandoned rifts tectonically active? Morphotectonic evidence from the Gulf of Suez

David Fernández-Blanco¹, Gino de Gelder², and Christopher A-L. Jackson¹

¹Basins Research Group (BRG), Department of Earth Science & Engineering, Imperial College, London, SW7 2BP, UK
²ISTerre, CNRS, Université Grenoble Alpes, France

Intra-continental abandoned rifts can fail for many reasons and are typically considered to be tectonically inactive. It is widely thought that the Oligo-Miocene Suez Rift, Egypt, which is located at the propagating northern end of the Red Sea spreading ridge, was abandoned in the Pliocene when motion between the African and Arabian plates was accommodated instead by the sinistral Dead Sea transform fault. However, local evidence for Plio-Quaternary normal faulting, the presence of uplifted Quaternary shorelines along the rift margins, and low-magnitude but widespread seismicity, together suggest the Suez Rift is tectonically active. Here, we present the first detailed analysis of this post-“abandonment” tectonic activity. We analyze the fluvial and tectonic geomorphology of the rift using freely available, 30 m-horizontal resolution digital elevation models (DEMs). These data reveal widespread normal fault offsets of Plio-Quaternary rocks at outcrop-to-basin scale, even in rift sectors >250 km north of the southern terminus of the rift. River morphology, tectonic knickpoints, normalized steepness indexes (ksn), and chi (χ) maps also provide evidence for relatively young faulting. Uplifted Quaternary shorelines show that active normal faults have footwall uplift rates of up to 0.125 mm/yr, even in locations >200 km north of the rift terminus, with these rates being relatively consistent for both rift margins. Our preliminary results provide clear evidence for young and ongoing tectonic activity in the Suez Rift and thus question the notion that this evolving plate boundary is currently in a state of complete tectonic quiescence. We speculate that the present tectonic activity in the Suez Rift results from the translation of far-field stresses imposed by the Afar plume, or by a recent change in the Eulerian pole of rotation between the African and the Arabian plates. Our results call for further analyses of the recent rifting in the Suez Rift and the exploration of recent activity in other “abandoned” rifts.