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Aborted propagation of the Ethiopian Rift in the Turkana depression caused by linkage with the Kenyan rift

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Continental rift systems commonly form by progressive growth of isolated rift segments that interact and link, eventually evolving into continuous zones of deformation. Propagation and interaction between adjacent rift segments are important features of rifting, influencing the distribution of volcanoes, seismicity and sedimentary basins. The process also controls the morphology of the rift at breakup with possible implications for the segmentation of mid-ocean ridges. However, how the punctuated, discontinuous zones of extension propagate and interact to form a continuous rift system and how the complex zones of interaction evolve remain poorly documented and understood. The Turkana depression in East Africa is an ideal place where to analyse these processes: within this NW-SE lowland, two major sectors of the East African rift, the Kenyan and Ethiopian rifts, interact giving rise a complex, >300km-wide region of faulting and volcanic activity.
In this work, we present geological-structural, geochemical and geochronological data from the poorly documented Ririba rift (South Ethiopia), which is part of the complex, wide region of volcano-tectonic activity in the Turkana depression. This rift is of special interest because it is commonly accepted to represent the southernmost, youngest and less-developed sector of the Ethiopian Rift, having formed from recent southward propagation of this rift into the Turkana depression. Our data confirm the Ririba rift formed from the southward propagation of the Ethiopian rift during the Pliocene but this propagation was short-lived and aborted close to the Pliocene-Pleistocene boundary, when rift-related deformation ceased. Integration of seismicity data with new numerical models indicates that abandonment of laterally offset and overlapping tips of the Ethiopian and Kenyan rifts resulted from progressive focusing of the tectonic and magmatic activity into an oblique, throughgoing rift zone which directly connects the rift sectors. These sectors link by near pure extension without forming the strike-slip transfer faults interpreted as precursors of oceanic transform faults