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New insights on segmentation of fault and magmatic systems in the Main Ethiopian Rift

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Magma-rich continental rifts comprise en-echelon magmatic segments where magmatism and extension are localised, similar to slow and ultra-slow spreading centres. While rift segmentation is clear in mid-ocean ridges, it is less so in continental rifts like the Main Ethiopian Rift (MER). Faulting within the MER initiated at ~11Ma at the border faults which define the overall NE trend of the MER and are oblique (30°-45°) to the E-W extension direction. However, since ~2Ma extension has localised to the right-stepping Wonji Fault Belt (magmatic segments), in which small offset faults and alignments of volcanic features strike roughly orthogonal to the extension direction. Despite this general framework, there is a lack of quantitative analysis to understand rift segmentation and its relationship to volcanic systems, and how segments interact. It is unclear how the ratio of magmatic to tectonic processes varies along rift segments.

Using optical satellite imagery and SRTM digital elevation data with a resolution of 1 arc-second, we map fault traces, calderas, and volcanic craters in the central and northern MER at a scale of 1:100,000. We also map scoria cones in the same region using optical imagery at 1:20,000. This data is integrated with existing MER datasets, including previously mapped fault traces, digital elevation models, mafic intrusions derived from gravity data, InSAR-derived locations of magma bodies, and recent dyke intrusions between Fentale and Dofan to define the magmatic segments. We investigate characteristics and scales of MER magmatic segments by analysing fault trace patterns, along-segment displacement variations, elevation profiles, the distribution of volcanic activity, and shallow crustal density structures.