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High magma flux feeding silicic systems during mature continental rifting demonstrated by steady gravity increase at Corbetti caldera, Ethiopia.

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Large silicic magma reservoirs preferentially form in the upper crust of extensional continental environments such as continental rifts or local zones of transtension. Growth by the incremental addition of magma to a crystal-rich mush should result in uplift, but geodesy alone cannot discriminate between magma injection, late- stage volatile saturation, long-term viscoelastic behaviour or hydrothermal processes. The lack of unequivocal observations limits our quantitative understanding of two key components of the Earth system: silicic reservoirs and magmatic rifts. Here, we focus on Corbetti, a peralkaline caldera in the densely-populated Main Ethiopian Rift, which has been steadily uplifting at < 6.6 ± 1.2 cmyr^{-1} for > 8 years and lies above a focused zone of upper mantle partial melt. We show that a concomitant residual gravity increase of < 9 ± 3 μGalyr^{-1} between 2014-2016 requires a mass flux of > 10̆10 kgyr^{-1} at 6 – 8 km depth, an order of magnitude greater than the long-term eruption rate. The derived source density of $2470 - 2770$ kgm-3, is consistent with the intrusion of mafic magma to the base of the silicic reservoir. We conclude that magma pathways feeding silicic systems play a more significant role in magma transport than currently considered by 2-D models of continental rifting.