High magma flux beneath Corbetti caldera (Ethiopia) accommodated by a ductile and compressible reservoir

J. Gottsmann[1], J. Biggs[1], R. Lloyd[1], Y. Biranhu[1], E. Lewi[2]

1) University of Bristol, United Kingdom
2) University of Addis Ababa, Ethiopia

Research funded by the NERC through the RiftVolc project (NE/L013932/1)

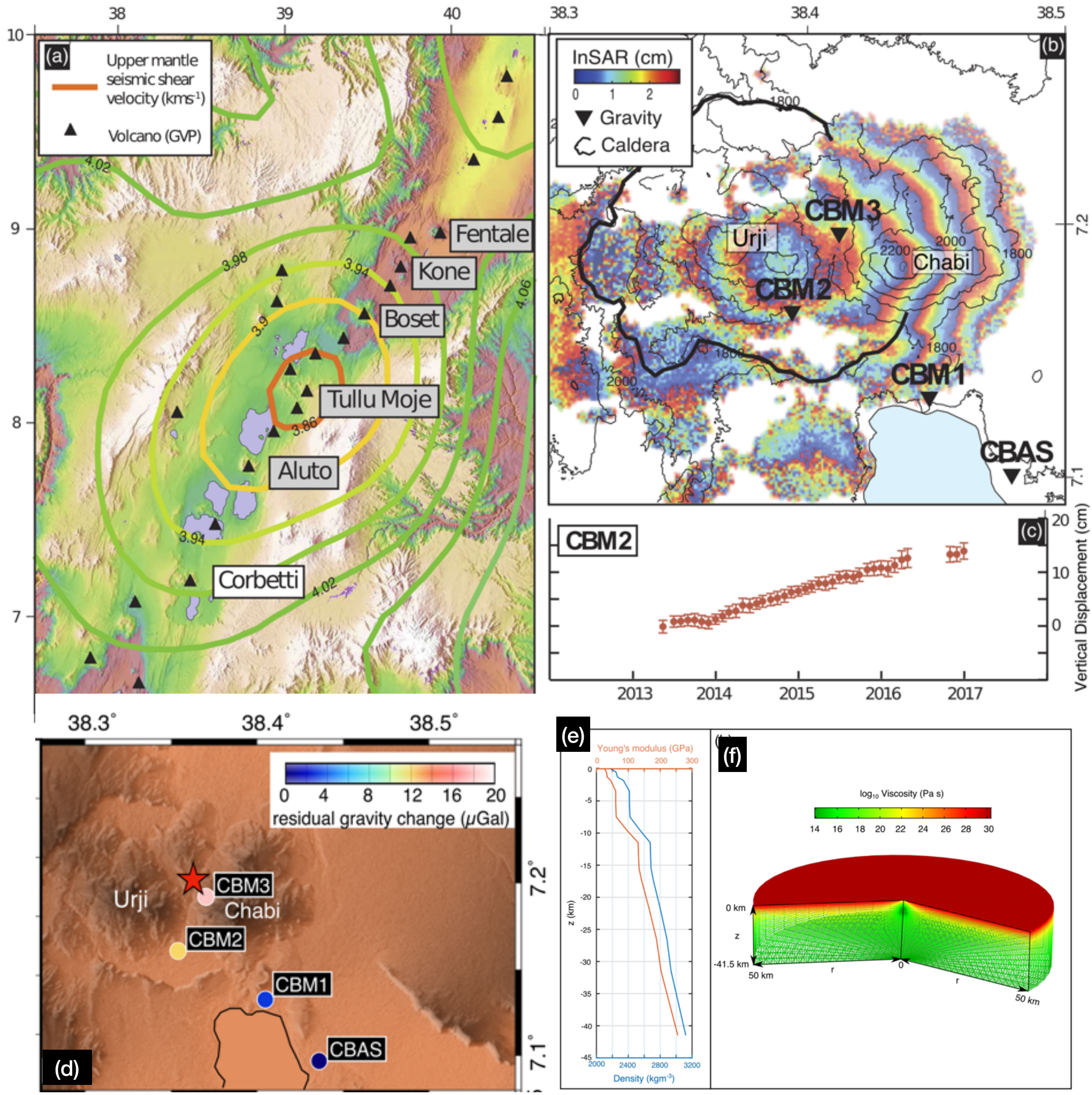
See also paper published open-access in G-cubed: https://doi.org/10.1029/2020GC008952

Motivation

Magma generation, transport and eruption (a) are key processes during continental rifting and lithospheric breakup.

However, the processes and timescales by which upper mantle mafic and upper-crustal silicic magma reservoirs form and interact remain poorly quantified.

Here we present joint ground deformation (b, c) and time-lapse gravity data (d) and thermomechanical numerical modelling (e, f) to elucidate the timescales, rate, and structure of magma supply beneath Corbetti caldera, an active silicic center in the Main Ethiopian Rift.



Findings and Implications

Corbetti uplifting at a maximum rate of 6.6 ± 1.2 cm/yr since 2009 with a maximum concomitant residual gravity increase of 9 ± 3 μGal/yr.

Numerical modeling shows the intrusion of mafic magma at ~7 km depth into a compressible and inelastic crystal mush best explains the observed deformation and gravity changes (a).

The derived magma mass flux of ~10^{11} kg/yr is anomalously high and at least 1 order of magnitude greater than Corbetti's mean long-term mass eruption rate.

Cumulative volume change at Corbetti matches or exceeds most recent dyke intrusions in regions of slow to moderate extension in the East African Rift System (b).