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Imaging magma storage in the Main Ethiopian Rift with 3-D Magnetotellurics

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The Main Ethiopian Rift (MER) as part of the large East African continental break-up zone is characterized by lateral extension and active volcanism. Rifting in the MER is magma assisted, with surface expressions of magmatism concentrated at en echelon Quaternary magmatic segments and off-axis linear features, but questions still remain about their respective roles in rifting.

The storage and pathways of magma ascent are of great interest for the assessment of both geohazard and geothermal energy potential. Imaging magma storage throughout the crust and in the upper mantle can be achieved by geophysical deep sounding techniques such as magnetotellurics (MT). Through MT measurements it is possible to access the electrical conductivity of the subsurface, a parameter that is greatly sensitive to the melt and water content. We present new MT data from the Central MER and a three-dimensional model of conductivity of the crust, imaging across-rift magma storage not only under the well-developed central-axis silicic volcanic complex Aluto, but also under several off-axis basaltic monogenetic volcanic fields. The conductivity model supports the idea of bi-modal magma storage in the CMER and helps constrain the melt and water content in the crust through the use of petrological melt-mixing models. Integrating our findings with the results from seismic tomography and receiver functions as well as Bouguer gravity data and petrological observations allows a comprehensive picture of magma storage and pathways in the MER.