Magnetotelluric imaging of the Kivu rift system

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SUMMARY

The Kivu rift system, a small part of the East African Rift system, hosts two active volcanoes, Mt Nyiragongo and Mt Nyamuragira, the former of which erupted most recently in 2021. The eruption led to a graben opening from the southern flank of Mt Nyriagongo southwards and beneath Lake Kivu. Past seismic activity in 2002 was also interpreted as a dike intrusion, possibly leading to the observed seismicity and graben opening in 2021. The dike intrusion extends beneath Lake Kivu, where the lake's bottom water has high concentrations of dissolved methane and CO_2, probably due to magmatic degassing. This presents a significant geohazard to the more than one million residents living on the shore of Lake Kivu. The region, therefore, requires the understanding of magma-fault interaction and imaging the dike intrusion to estimate the hazards due to seismicity, magmatism, and potentially suffocating limnic eruptions.

To image the regional electrical structure and study the north-south tending dike intrusion, we carried out a land MT survey in June 2023 consisting of 11 stations in western Rwanda, alongside geodetic and seismic deployments as part of a multidisciplinary study of the systen. Due to the hilly terrain and high population density in Rwanda, the MT dataset we collected proved challenging to process. Our imaging is further complicated by the skewed distribution of the stations towards the Rwandan (eastern) side of the dike intrusion. The preliminary results using standard processing tools on a relatively noisy dataset influenced by widespread powerlines indicate that the MT data are one-dimensional for a large spectrum of frequencies. We, therefore, aim to obtain the first conductivity imaging of the subsurface using the traditional Occam1D inversion method and extend the work to get the uncertainties associated with the inverted models using stochastic inversion schemes.

Keywords: magnetotelluric, dike intrusion, Kivu rift system, inversion