Crustal and upper Mantle Imaging of Botswana Using Magnetotelluric Method: What Can We Learn from Country-wide Magnetotelluric Imaging?

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Abstract

Botswana is located at the centre of southern Africa, where major tectonic features intersect and interact, e.g., the anomalous topography of the African-superswell, the termination of the East African Rift System, and the boundaries of the cratons and mobile belts. Moreover, Botswana is a major player in the production of critical raw earth materials. Therefore, the study of Botswana's crust and upper mantle gives more insight into the tectonic development of the region and improves our understanding of the distribution of Earth resources and natural hazards. Although novel country-wide geophysical data have been compiled and processed in the last two decades, some unclear and debated hypotheses about important tectonic features and the geodynamics of Botswana from various geophysical studies still exist. This includes the debate about the existence of a buried Maltahohe microcraton in the southwest region, the mechanism of the rifting in the Okavango Rift Zone, and the further extension of the East African Rift System to central Botswana. This research presents a homogenous 3-D electrical model with unprecedented spatial coverage, using a robust 3-D methodological scheme. We used magnetotelluric data from 355 stations throughout Botswana to derive an electrical conductivity model. The result of this research provides straightforward, connected, and precise geologic interpretations about different arguments raised in the literature on the tectonics and structure of the crust and upper mantle beneath Botswana. The model shows interesting features, including the major cratonic blocks, a separate cratonic structure – Maltahohe microcraton in southwest Botswana, and the mobile belts. Furthermore, the model gives new insight into the Okavango Rift Zone and the extension of the East African Rift System to Botswana. Our results overcome the fragmented nature of the previous studies and the incoherent methodologies and approaches that have led to some misleading or conflicting interpretations.

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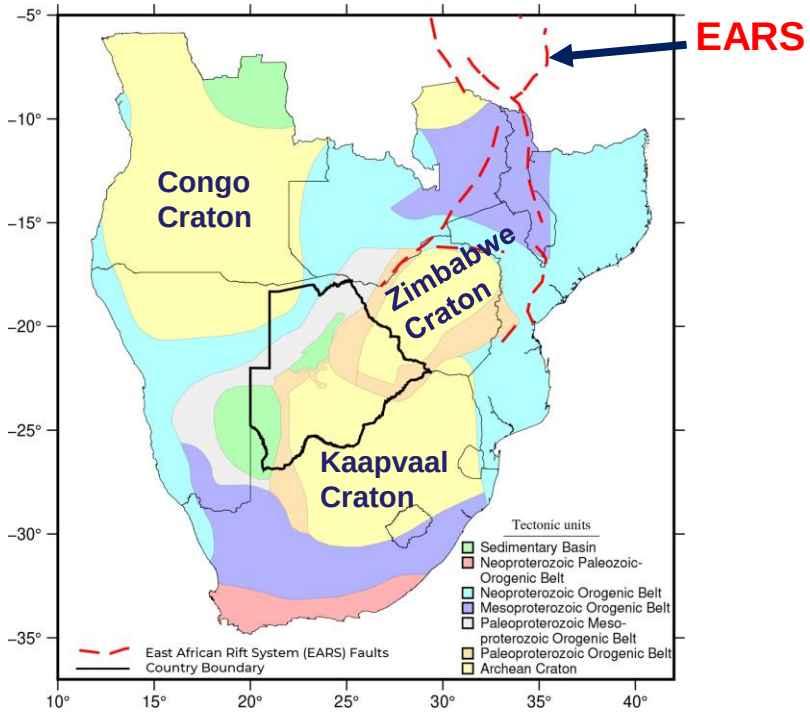
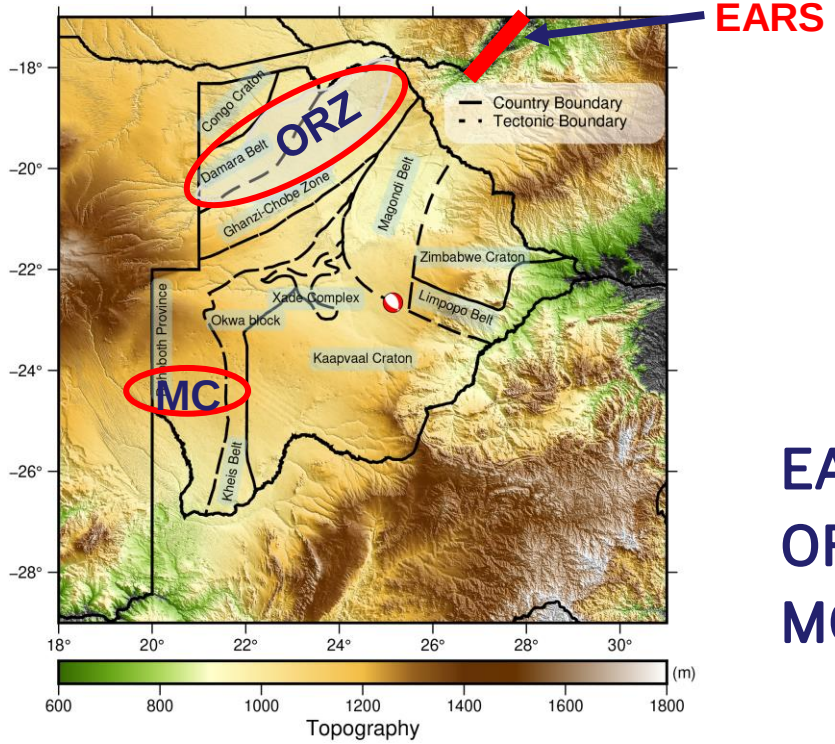
TECTONICS OF BOTSWANA





EARS – East African Rift System;
ORZ- Okavango Rift Zone;
MC – Maltahohe Microcraton

Debated Hypothesis about the Tectonics of Botswana:

1. Existence, location, and boundaries of a MC in southwest Botswana
2. EARS rift extension, rifting and rift mechanism in ORZ.

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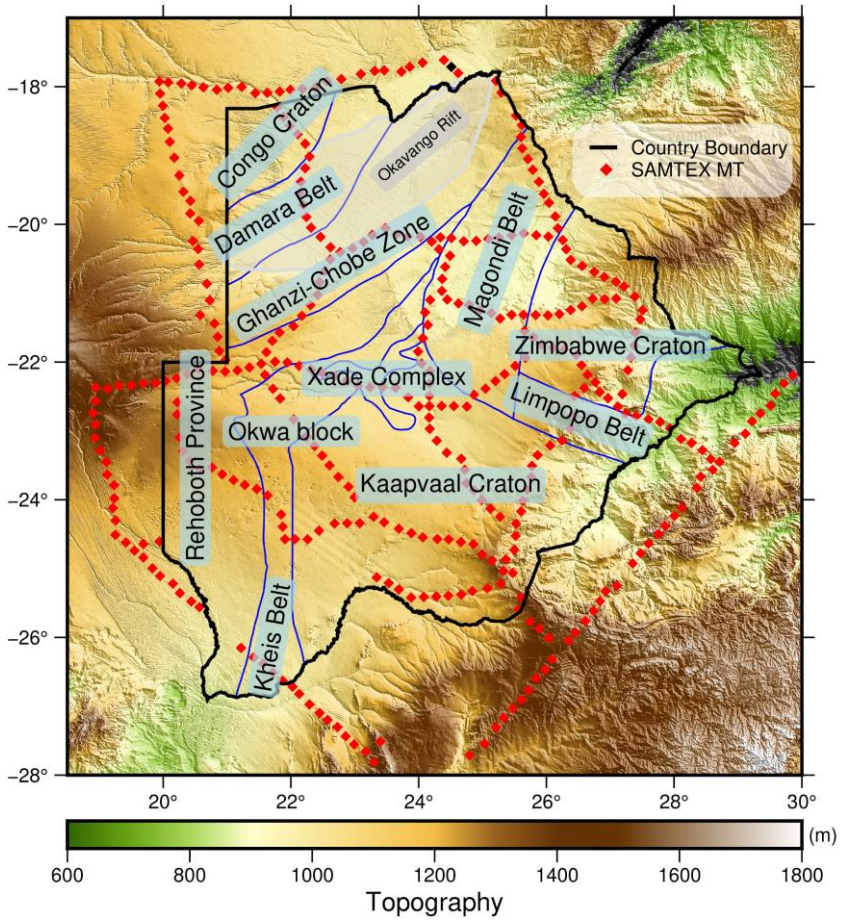
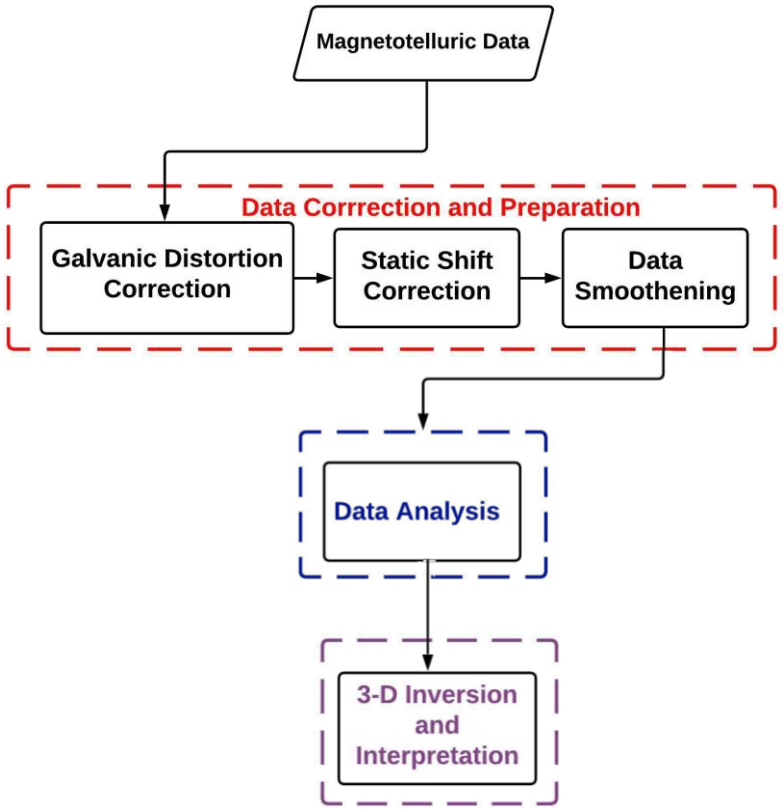
DATA AND METHODS



Southern Africa Magnetotelluric Experiment (SAMTEX) Data



Methodological Workflow

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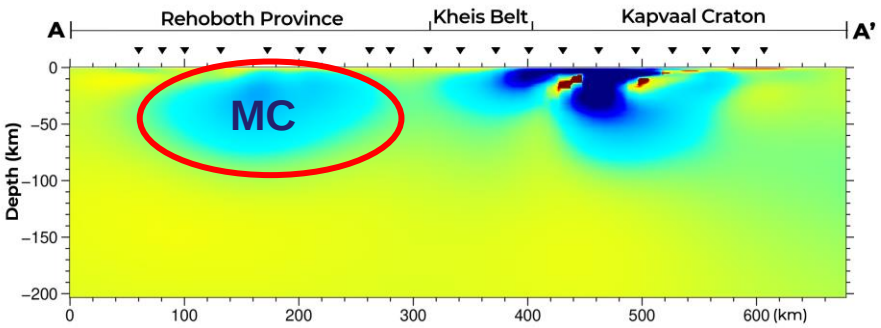
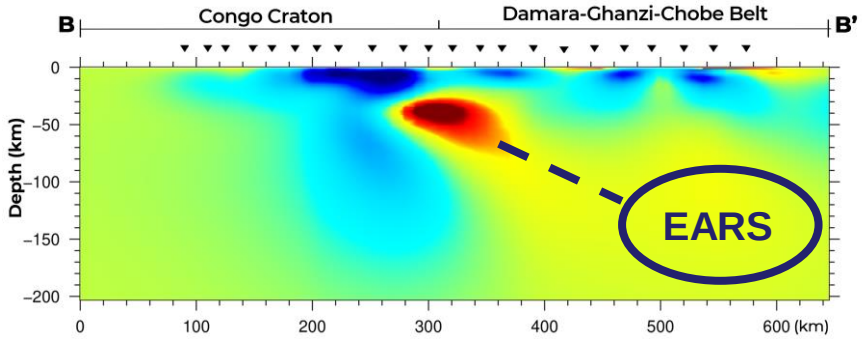
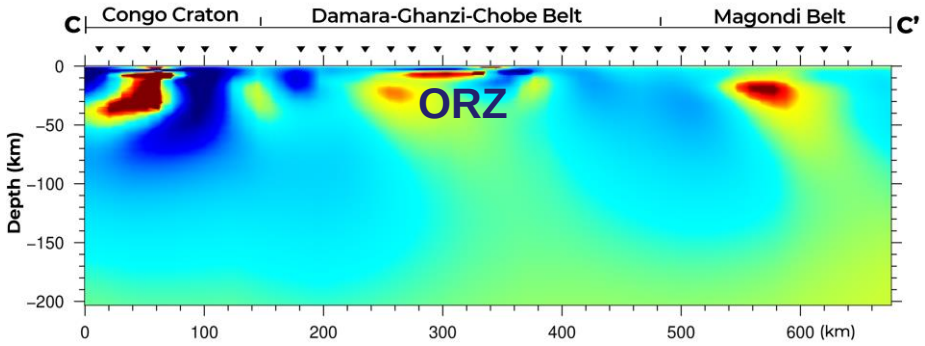
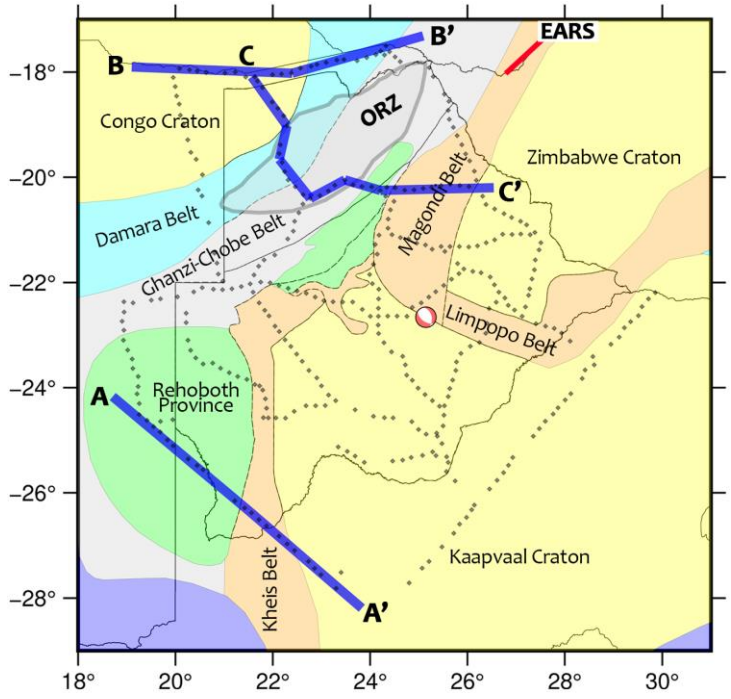
THE ELECTRICAL MODEL









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EARS – East African Rift System; ORZ- Okavango Rift Zone; MC – Maltahohe Microcraton

CONCLUSION

- A distinctive resistive structure in southwest Botswana suggests the existence of the MC as a separate cratonic unit.

- We suggest that ascending hot fluids or melt from the EARS play significant role in the incipient continental rifting in the Okavango Rift Zone.

THANK YOU

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