What are the compositional causes behind electrical conductivity variations in continental lithospheric mantle? Methodology and practice for quantified interpretations.

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SUMMARY

Since the electrical conductivity can be used as a proxy for many properties of the earth media, the magnetotelluric method remains one of the most powerful tools for unveiling the lithospheric architecture. However, the compositional nature behind variations in electrical conductivities is often under-interpreted. This practice primarily stems from the non-uniqueness in solutions acquired via deterministic inversion techniques and hardship in tying them to the vast literature of experimental petrology and electrical conductivity studies.

We demonstrate a review of methodologies used in making such quantified interpretations of magnetotelluric models centering the use of the MATE software (Özaydın and Selway, 2020, https://github.com/sinanozaydin/MATE) and portray the findings of such analysis from case studies in Southern Africa (Özaydın et al, 2021, 2022), Eastern Australia, Tanzania and Continental US.

Detailed comparison of xenoliths and xenocrysts from Southern Africa and recently-developed 3D magnetotelluric models demonstrate that such relationships between composition and electrical conductivity indeed exist. However, they constitute a complex phenomenon that requires careful analysis, which should include the emphasis on style, recurrence and intensity of metasomatism alongside the initial formation and age of the lithosphere in the first place.

Relationships between mantle-derived magma (e.g., kimberlites) and electrical conductivity; also exist according to analyses made from MT models around the Earth and spatial distribution of kimberlites. This finding supports magma transport mechanisms for kimberlites are controlled by lithospheric composition.

Keywords: lithospheric mantle, electrical conductivity, cratons, kimberlites, metasomatism

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