Delft University of Technology

Unveiling the lithosphere below Northeast Africa: Insights from 3-D electrical resistivity models and joint inversion

Marzouk, Hossam ; Arafa-Hamed, Tarek ; Becken, Michael; Comeau, Matthew J.

Publication date
2024

Document Version
Final published version

Citation (APA)
Marzouk, H., Arafa-Hamed, T., Becken, M., & Comeau, M. J. (2024). *Unveiling the lithosphere below Northeast Africa: Insights from 3-D electrical resistivity models and joint inversion*. Abstract from 26th International Electromagnetic Induction Workshop 2024, Beppu, Japan. https://www.emiw.org/emiw2024/abstracts/abstract-listing/pmfe-abstract-details?tx_powermail_pi2%5Baction%5D=show&tx_powermail_pi2%5Bcontroller%5D=Output&tx_powermail_pi2%5Bmail%5D=4115&cHash=9057d4c86ef2b0267f63e89292768eeb

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

This work is downloaded from Delft University of Technology.
For technical reasons the number of authors shown on this cover page is limited to a maximum of 10.

Unveiling the lithosphere below Northeast Africa: Insights from 3-D electrical resistivity models and joint inversion

Hossam Marzouk[1,2], Tarek Arafa-Hamed[2], Michael Becken[1], Matthew J. Comeau[3]
[1]Universität Münster, Germany, H.Marzouk@uni-muenster.de, Michael.Becken@uni-muenster.de,
[2]National Research Institute of Astronomy and Geophysics (NRIAG), Egypt, Tarek.Arafa@nriag.sci.eg
[3]Delft University of Technology, The Netherlands, M.J.Comeau@tudelft.nl.

SUMMARY

The tectonic evolution of Northeast Africa, particularly the interaction between the Saharan Metacraton and the Arabian-Nubian Shield in Egypt, remains poorly understood due to the lack of deeply-penetrating geophysical data that can shed light on lithospheric structures. We present magnetotelluric data along a 700 km profile that was acquired to reveal the lithosphere's composition, thickness, and thermal state, thereby contributing to a better understanding of the tectonic evolution in the region. The survey was strategically conducted in regions with diverse geological and tectonic settings, including the Saharan Metacraton in the Western Desert, the Arabian Nubian Shield in the Eastern Desert, and the Nile Delta. A total of 58 stations were deployed with dense coverage, <5 km, in regions with complex geological settings and sparse, ~20 km, in other regions with less geological complexity. Phase tensor analysis revealed the complexity of the acquired dataset in which more than 35% of the calculated impedances have a high skew angle of (>3°), requiring 3-D inversion schemes to efficiently recover the existing structures. The generated 3-D electrical resistivity model illustrates the resistivity distribution along the tectonic boundaries. The Nile Valley region, characterized by significant sedimentary deposits, shows a complex resistivity pattern. The upper crust is highly conductive, consistent with thick sedimentary layers, while deeper sections reveal heterogeneous resistivity indicative of tectonic reactivation and sedimentary basin evolution. The Saharan Metacraton appears as a massive, high-resistivity feature, typical for a cratonic block. However, it includes an anomalous low-resistivity feature that is interpreted to be related to the deformation and remobilization of a cratonic remnant. The electrical signature of the Arabian Nubian Shield shows a resistive upper crust corresponding to the predominantly crystalline and igneous rocks, such as granitoids and gneisses, which form the bulk of the shield. Magnetic and gravity data were combined with the electrical resistivity model in a joint inversion approach to enhance the accuracy and confidence in the interpretations by cross-verifying the findings from multiple sources. The magnetotelluric survey across Northeast Africa, integrating joint inversion with magnetic and gravity data, has provided detailed insights into the lithospheric structures, revealing complex resistivity patterns indicative of tectonic reactivation and sedimentary basin evolution. These findings significantly enhance our understanding of the tectonic interaction between the Saharan Metacraton and the Arabian-Nubian Shield in Egypt, highlighting the need for further deep geophysical investigations.

Keywords: Magnetotelluric; Resistivity; Inversion; Arabian Nubian Shield; Saharan Metacraton

EMIW2024 abstracts are distributed under the Creative Commons Attribution 4.0 Unported License.
Authors retain the copyright of the abstract but grant any third party the right to use the abstract freely as long as its original authors and citation details are identified.
To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/