An integrated and interoperable platform enabling 3D stochastic geological modelling

Preliminary magnetic and gravity inversions for the Yaouré Greenstone Belt, Ivory Coast, West Africa

Vinicius Antunes[1*], Vitaliy Ogarko[1], Mark Jessell[1], and Jérémie Giraud[12]

[1]Centre for Exploration Targeting, The University of Western Australia, Australia

[2]RING, GeoResources, Université de Lorraine, France

*vinicius.antunes@research.uwa.edu.au

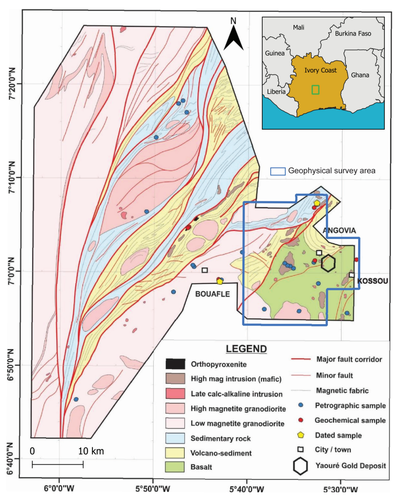
1. INTRODUCTION

Greenstone belts are sequences primarily composed of mafic volcanic rocks, with subordinate sedimentary components. They are the main rock type in Archean-Proterozoic cratons, hosting gold.

Geophysical inversion offers a robust method for obtaining geometric and physical property parameters of the subsurface of these sequences, aiding in resource exploration.

This study presents inverted 3D models of the Yaouré region, to analyse magnetic susceptibility and density distributions in relation to mapped geology.

2. STUDY AREA



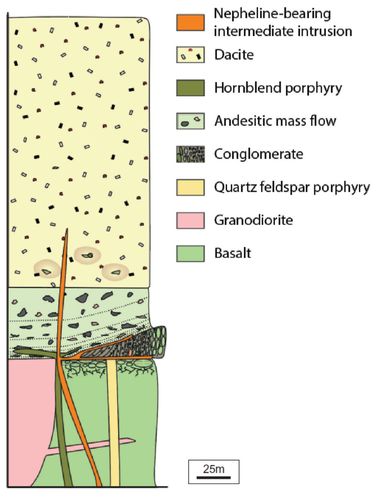


Fig. 1. Left - Geological map of the Bouaflé Greenstone Belt, highlighting the Yaouré gold deposit and the geophysical survey area. Right - Stratigraphic column of the Yaouré region (adapted from Mériaud et al. 2020, 2022).

3. MATERIAL AND METHODS

The survey included magnetic and full tensor gravity gradiometry (FTGG) measurements in 100-m-spaced NS flight lines with an average terrain clearance of 80 m.

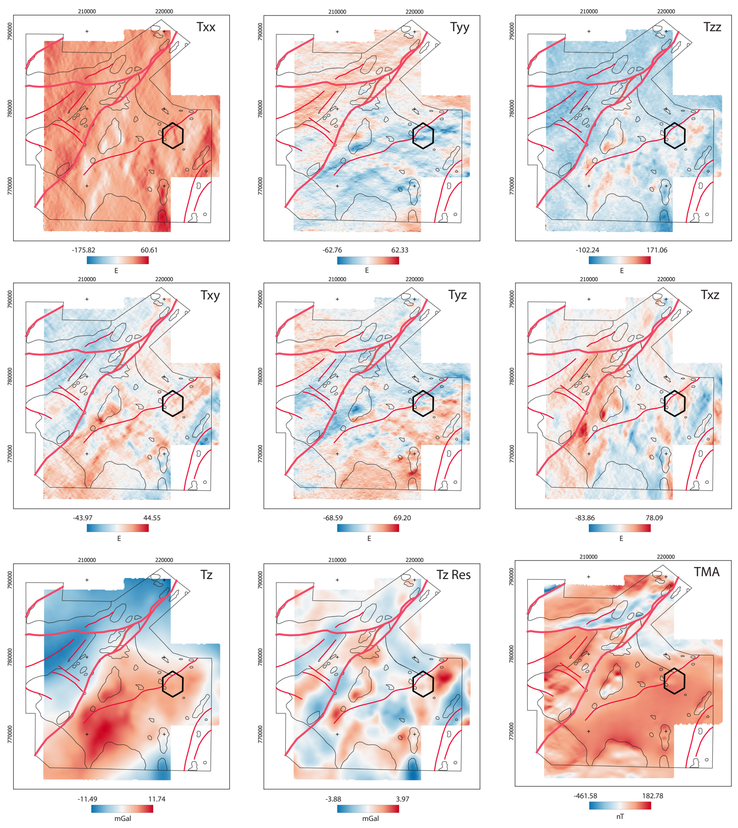


Fig. 2. Observed data used for the inversions, including FTGG grids (tensor components and the vertical gravity gradient Tz, along with its high-pass residual, Tz Res) and magnetic data (total magnetic anomaly - TMA - with trend removed), overlaid with geological units and structures. The data were downsampled to a cell size of 100 x 100 m.

Table 1. Processing and Inversion parameters.

Parameter	Details
FTGG Processing	Tz_Res: High-pass Butterworth filter (10 km cutoff)
Magnetic Data Processing	Regional trend removed, resulting in a mean of -20 nT
Software for Inversion	Tomofast-x https://github.com/TOMOFAST/Tomofast-x Giraud et al. (2021), Ogarko et al. (2024)
Interpolation Method	Minimum curvature on a 100 m grid
Core Mesh Cell Size	100 x 100 x 100 m
Core Mesh Volume	23 x 26 x 2 km (E-W, N-S, Depth)
Padding	10 km (horizontal), 8 km (depth)
Topography Source	ALOS PALSAR (12.5 m resolution)
Final Mesh Size	269 x 301 x 38 cells (Nx, Ny, Nz)
Final Mesh Volume	43 x 43 x 10 km (E-W, N-S, Depth)
Gravity Inversion	Unconstrained
Magnetic Inversion	Positivity constraint applied

4. RESULTS

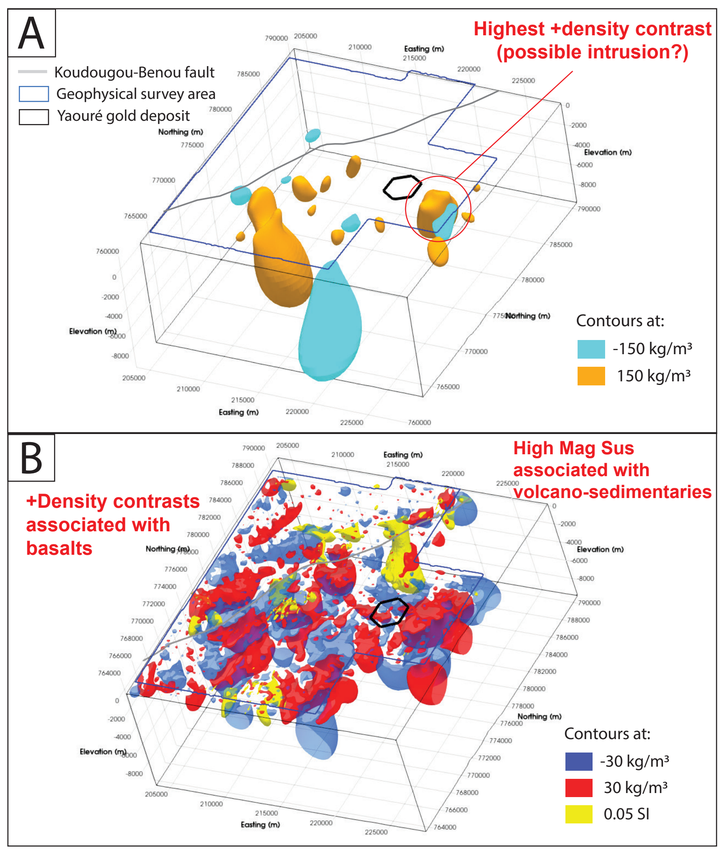
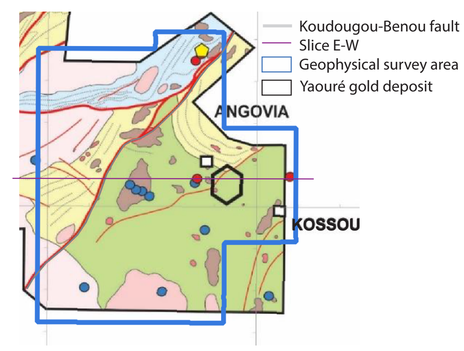
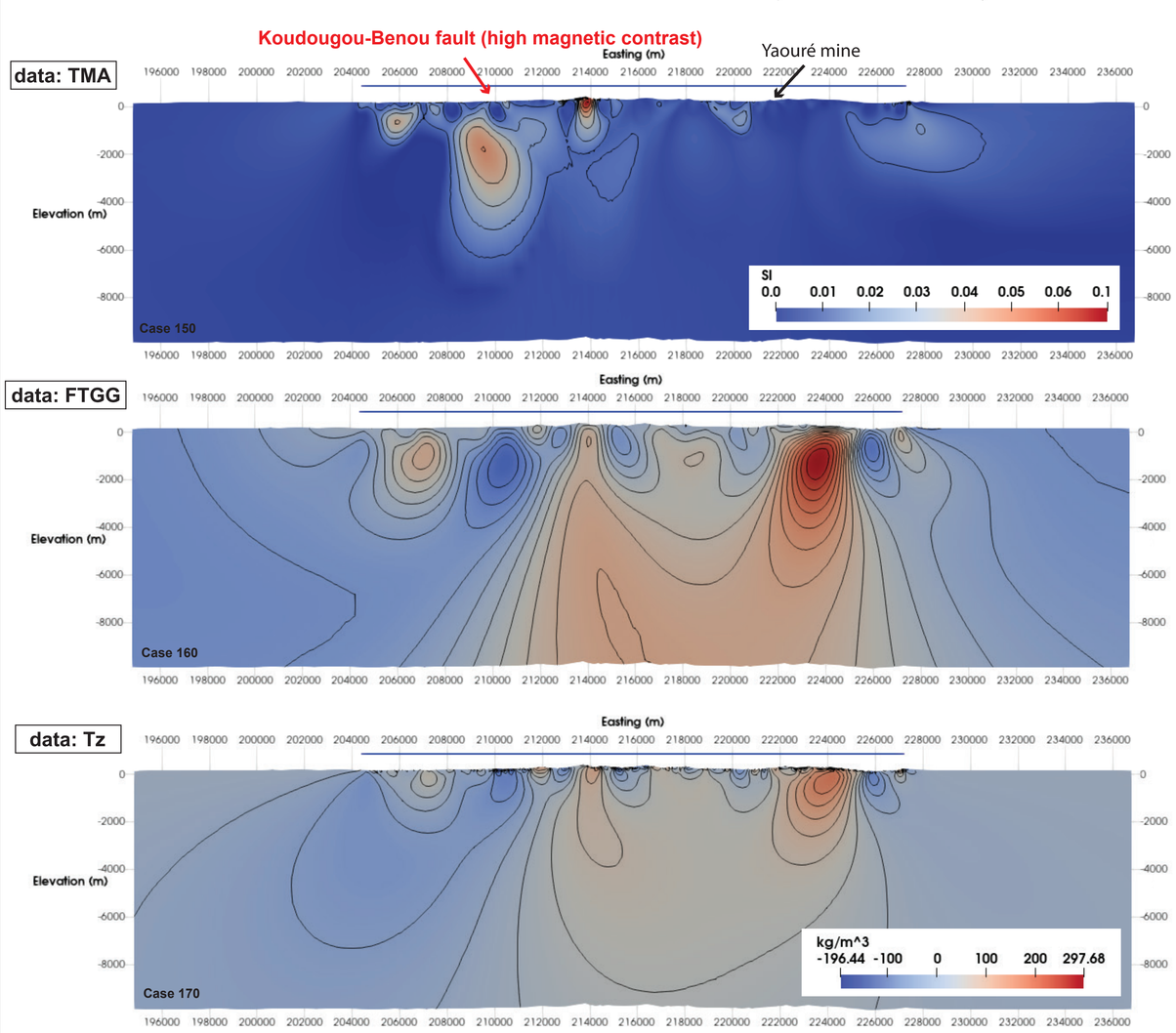


Fig. 3. A) Inverted density (from FTGG data) contour surfaces. B) Retrieved density (from Tz Res data) and magnetic susceptibility contour surfaces.

Fig. 4. E-W slices (map below indicates the location) from the 3D magnetic susceptibility (uppermost slice) and density models (from FTGG components, middle slice, and Tz, lowermost slice). Color bar is the same for both density slices. Contours are equally distributed.





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REFERENCES

Giraud, J. et al. (2021). Structural, petrophysical, and geological constraints in potential field inversion using the Tomofast-x v1.0 open-source code. Geosci. Model Dev. 14, 6681–6709.

Mériaud, N. et al. (2022). Fluid pressure–dominated orogenic gold mineralization under low differential stress: case of the Yaouré gold camp, Côte d'Ivoire, West Africa. Miner. Deposita 57, 539–556.

Mériaud, N. et al. (2020). Lithostratigraphic evolution of the Bandamian Volcanic Cycle in central Côte d'Ivoire: Insights into the late Eburnean magmatic resurgence and its geodynamic implications. Prec. Res. 347, 105847.

Ogarko, V. et al. (2024). Tomofast-x 2.0: an open-source parallel code for inversion of potential field data with topography using wavelet compression. Geosci. Model Dev. 17, 2325–2345.

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