Submission code: 4LA84J5BW9

See this and other abstracts on our website: https://home.sbgf.org.br/Pages/resumos.php

Lateral Density Variation Analysis in Complete Bouguer Anomaly Calculations: A Case Study in the Resende Basin.

Luiz Lagdem (GISIS/UFF), Leonardo Miquelutti (Universidade Federal Fluminense - UFF), Klauss Sampaio Silva (GISIS/UFF), Marco Cetale (GISIS/UFF)

Lateral Density Variation Analysis in Complete Bouguer Anomaly Calculations: A Case Study in the Resende Basin.

Abstract Summary

To investigate the lateral variation of the Bouguer anomaly of a zone, we created a code that calculates the complete Bouguer anomaly of an area of interest and isolates the density contribution of the anomaly. The results, exported as GeoTIFF files, offer enhanced insights into subsurface structures and the gravitational effects of mineralogical heterogeneities.

Introduction

This report uses the programming language Python to study the gravitational influence caused by the differences in density in an area of interest. The process of understanding this study comes from a thought experiment: “Since in the Bouguer Reduction of a Bouguer Anomaly we take account of the density, how much does the density contribute to its final value?” (Fowler, 2005). In this study, we will focus on the Resende Sediment Basin and the surrounding alkaline intrusions to investigate the Lateral Density-Varied Bouguer Anomaly and the contribution of different mineralogical compounds to its Bouguer Anomaly.

Method and/or Theory

To compute the Bouguer Anomaly in this work, we’ll use the Python Library “Harmonica” approach and primarily the function “harmonica.prism_layer” to do our designated task. The function requires a three-dimensional arrangement of coordinates and gravity data as input and outputs a grid of regular prisms, with the possibility of data storage, which in this case will be density and free-air gravity data. Once we have our grid set, we can create a shapefile mask of the alkaline intrusions in our area of interest and designate which prisms will have and designate different density values for the prisms that match the inside of the mask, following the local lithology (Rosa, 2017). The result of processing the prism’s grid and subtracting it from the free-air gravity data results in a bouguer anomaly, in this case, with the lateral density values now accounted for.

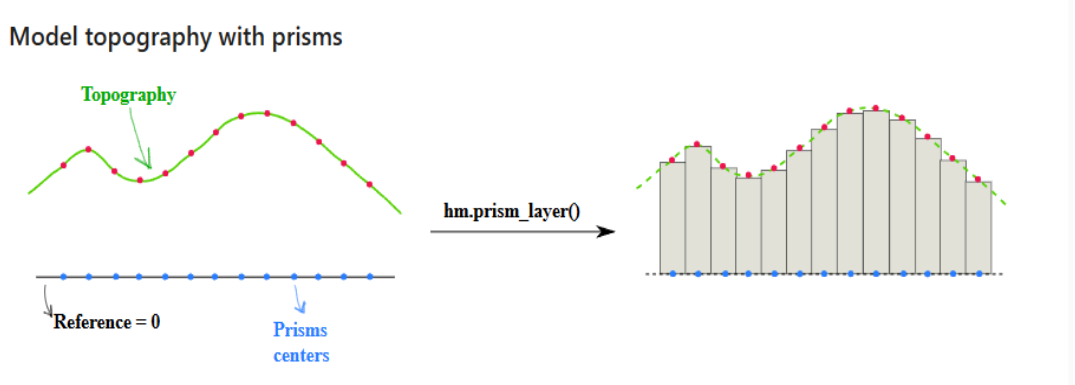
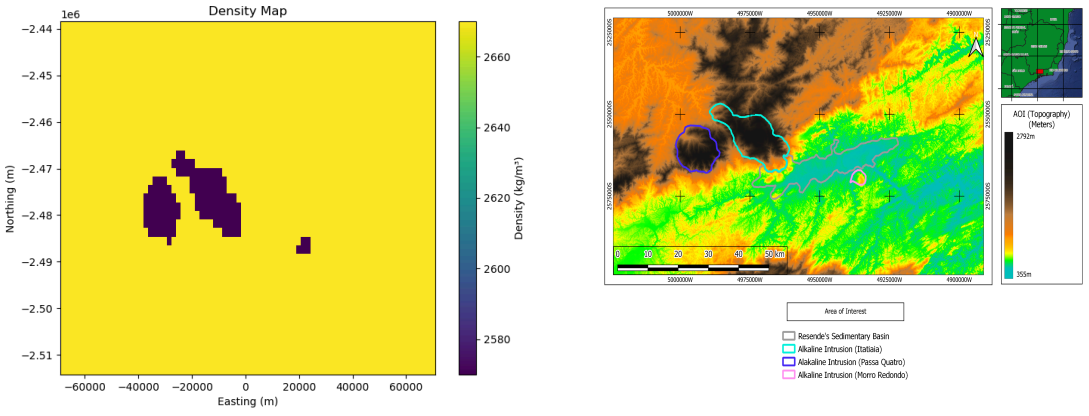


Figure 1: Representation of how the layer of prisms is gridded. Extracted transform21/process-gravity.ipynb at main · fatiando/transform21 · GitHub.



(a) (b)

Figure 2: Maps highlighting the alkaline intrusion: a) Representation of how the code represents the different densities by applying a shapefile mask. b) Topography map of the area of Interest.

Results

To validate our study, we'll compare our lateral density variated bouguer anomaly, with a traditionally computed bouguer anomaly, with constant density crust. Subtracting the traditional Bouguer Anomaly from the lateral density variated one will result in the difference between them, dividing again by the traditional Bouguer will result in the percentage difference. Both of the differences were transformed into Tagged image files (TIFF) for further analysis.

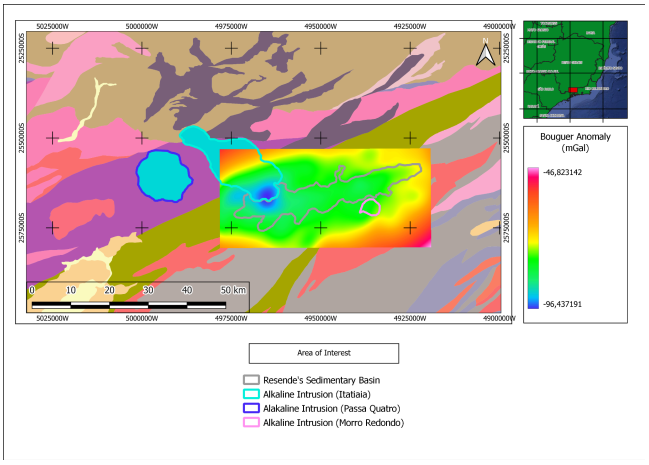


Figure 4: Map of the Bouguer anomaly with density = 2670 kg/m3.

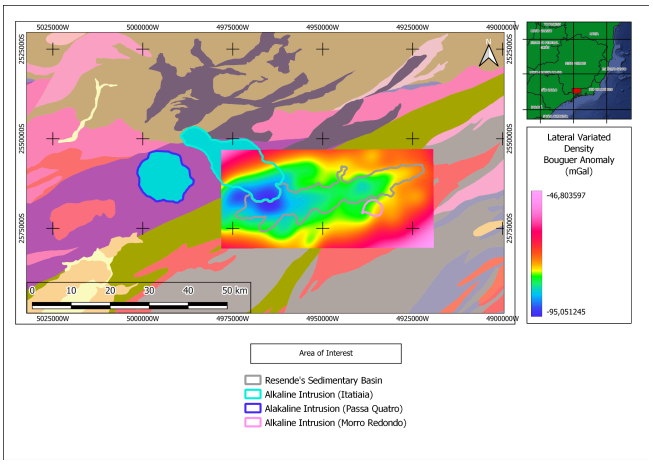


Figure 5: Map of the Bouguer anomaly with density = 2530 kg/m3.

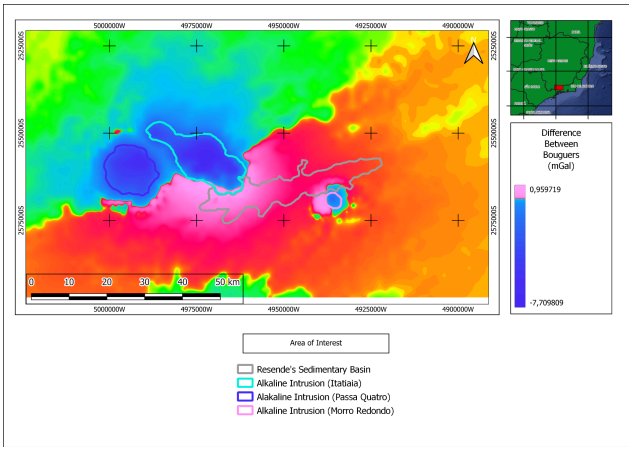


Figure 6: Map of difference between previous Bouguer anomalies.

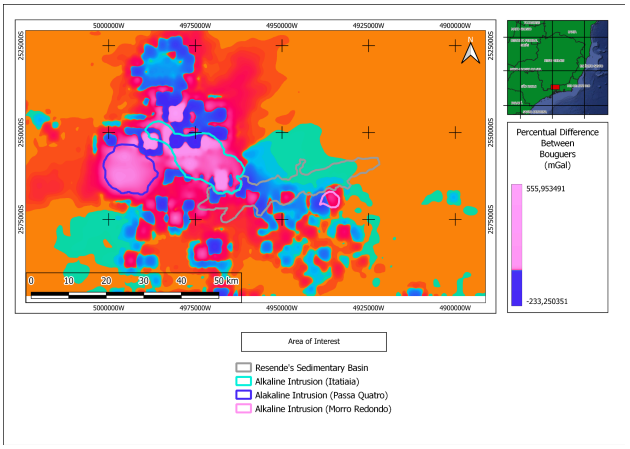


Figure 7: Map of percentual difference between Bouguer anomalies.

Conclusions

By comparing each Bouguer anomaly map, we managed to successfully isolate the density contribution interfering with the gravity data and express the numerical values of the anomaly for each point in the designated area.

Acknowledgments

The authors from Fluminense Federal University gratefully acknowledge the financial support provided by Petrobras through the R&D project *"Tectônica Cenozóica da Margem Continental do Sudeste do Brasil: padrões de deformação e controle na sedimentação"* (ANP No. 22969-0). The strategic relevance of the R&D levy regulation by the Brazilian National Agency for Petroleum, Natural Gas and Biofuels (ANP) is also sincerely appreciated. We extend our gratitude to the Seismic Inversion and Imaging Group (GISIS) for providing access to their infrastructure and for their valuable assistance throughout the development of this study. We also thank the Porto Real Group for authorizing geophysical operations on their properties.

References

Fowler, C. M. R. (2005). *The Solid Earth: An Introduction to Global Geophysics* (2nd ed.). Cambridge University Press.

Rosa, P. A. da S. (2017). *Geology and petrogenetic evolution of the Itatiaia alkaline massif, MG-RJ* (Doctoral Dissertation, Universidade de São Paulo). Instituto de Geociências, Universidade de São Paulo.