



SBGf Conference

18-20 NOV | Rio'25

Sustainable Geophysics at the Service of Society

In a world of energy diversification and social justice

Submission code: 5M4AXWQV8W

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

Mineral Potential Model Applied for LCT-Pegmatites Prediction in the Volta Grande Li-Deposit Region, Minas Gerais, Brazil

Marco Couto (Institute of Geosciences; University of São Paulo), Vinícius Louro (Mineral Resources; Commonwealth Scientific and Industrial Research Organisation (CSIRO)), Maria Helena B.M. Hollanda (Universidade de São Paulo)

Mineral Potential Model Applied for LCT-Pegmatites Prediction in the Volta Grande Li-Deposit Region, Minas Gerais, Brazil

Copyright 2025, SBGf - Sociedade Brasileira de Geofísica/Society of Exploration Geophysicist.

This paper was prepared for presentation during the 19th International Congress of the Brazilian Geophysical Society held in Rio de Janeiro, Brazil, 18-20 November 2025. Contents of this paper were reviewed by the Technical Committee of the 19th International Congress of the Brazilian Geophysical Society and do not necessarily represent any position of the SBGf, its officers or members. Electronic reproduction or storage of any part of this paper for commercial purposes without the written consent of the Brazilian Geophysical Society is prohibited.

Introduction

Lithium (Li) is a critical mineral for energy transition and has been a primary target for mining companies of all sizes. The region of the Volta Grande Deposit (VGD), in Minas Gerais, Brazil, displays high exploratory potential for Lithium-Cesium-Tantalum (LCT) pegmatites, given its favorable geological settings and evolution. Exploring such targets effectively requires comprehensive understanding of the whole Mineral System (MS), as traditional exploration methods independently assessed and overlaid often lack this characteristic. Integrating geoscientific data with the geological knowledge under the MS paradigm provided a leap in the exploratory potential of the VGD surroundings. Geophysics can highlight magnetic features and indicate K and U enriched zones linked to mineralization. Multispectral images can define surface mineralogical features related with it. Geological data provides lithological and structural constraints, although restricted to field observation sites. Manually integrating these different datasets is time-consuming, demands different levels of expertise and is prompt to bias. Mineral Potential Models (MPM's) using Machine Learning (ML) techniques synergically fuse them, as it is inherently less affected by knowledge bias – although bias on data distribution must be considered. Under the MPM approach, this study presents a feature selection and supervised ML pipeline to evaluate LCT-pegmatite favourability around the VGD as a Li exploration proxy.

Methods

We integrated public airborne magnetics and radiometrics datasets (Companhia de Desenvolvimento de Minas Gerais - CODEMGE surveys), multispectral images (Advanced Spaceborne Thermal Emission and Reflection Radiometer - ASTER mission) and the digital terrain models (generated from the Shuttle Radar Topography Mission – SRTM) to investigate the predictive favourability for LCT-pegmatites occurrences in the study area. Each dataset was processed following specific workflows, e.g., Fourier-domain filtering for the magnetic data, relative isotopes calculations for radiometrics and the Crósta Technique for multispectral data. The geology data used as the target feature counted only with the positive cases, i.e. known LCT-pegmatite occurrences. Such limitation was overcome through the generation of 100 random training datasets of negative (non-LCT-pegmatites occurrences) and positive cases. A robust correlation analysis using the Point-Biserial Method was applied for the feature and best training datasets selection processes. A predictive automated supervised ML pipeline based on ensembles of different models was applied for each selected training dataset, enabling the calculation of mean probability maps for the LCT-pegmatites occurrence for the area of interest.

Results and Conclusions

The ML pipeline returned an ensemble of Naïve Bayes models, which mean probability values for the positive occurrences of LCT-pegmatites indicated good correlation with known structural controls and favorable lithologies, e.g., edges of granitic intrusions. The results seem to be reliable considering the influence from vegetation cover, allowing to distinguish high and medium risk exploration targets. A feature importance analysis was also conducted, which suggested that the U/Th ratio and the digital terrain model are the most important features for the prediction. The resulting MPM revealed areas of interest, besides those previously known and explored, to the northeast and southwest of the VGD, which will be targets for follow-up campaigns within the research project that this study is attached to (CNPq project process 407855/2022-0).