Study of the Catalão Alkaline Complex using Potentials Methods

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Abstract

This work is another contribution for the many geophysical studies aiming alkaline complexes. In this project the Catalão I alkaline complex will be analyzed using potential methods and gamaspectometry. Catalão I have a large economic interest, the carbonatite rock intrusions that occurred inside of the complex is one of them.

We are looking to identify the geophysical signature of the body, if is possible to identify the carbonatite within the complex using potential methods and make a 3-D model of the intrusive body.

Introduction

This project objective is to study the geophysical characteristics of the Catalão I ultramafic-alkaline-carbonatitic complex. The geophysical methodology used in this case were the gravimetry, which the data were acquired and reduced in this project, the magnetometry and radiometry, acquired by an air survey made by CPRM in 2005.

Catalão I alkaline complex is being explored by three different mining companies, Fosfértil, Anglo American and Copebás for the extraction of phosphate and others minerals. The alkaline complex is located in Goias - Brazil, near of the Catalao city (18°08'S, 47°48'W).

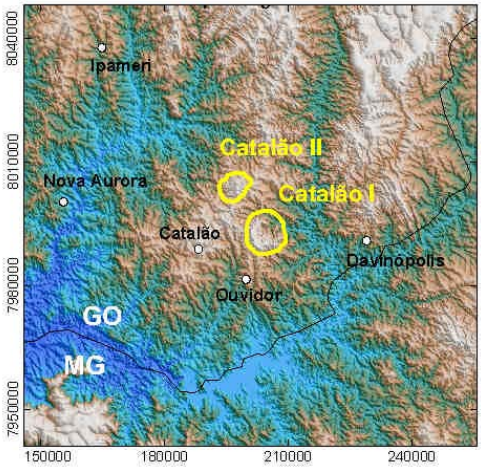


Figure 1: Regional location map

Regional Geology

The Catalão I ultramafic-alkaline-carbonatitic complex is one of he many Mesozoic alkaline complexes that can be found in the *Bacia do Paraná* boundaries, along deep fails in NW direction. This complex is located in the state of Goiás – Brazil, about 15km from Catalão city (18°08'S, 47°48'W). The alkaline dome is a sub circular platoon – axis NW (6km) and NE (5km) it's around 100m higher then the regional terrain – sustented by fenitized quartzite rocks, the fenitization occurred due the intrusion of the complex.

The Catalão I complex intrusion (Earlier Cretaceous ~ 85Ma) has deformed the metasedments (quartzites and micaxists) from Araxá Group (Middle Proterozoic). The body has an ultamafic primary fase, constituted by dunites and piroxenites, that was altered for folgopititics and clinopiroxenitics rocks due the intrusion of multiple carbonatitic fases.

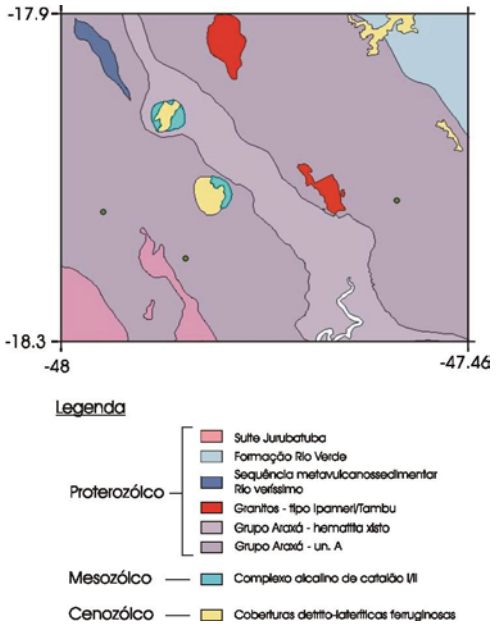


Figure 2: Regional Geology (modified from "Mapa geológico do Brasil ao Milionésimo" – CPRM, 2004)

Catalão I alkaline complex has many interesting minerals, like: apatite, piroclore, monazite, vermiculite and amastasie; but just the first and the second are being extracted. The main Catalão I phosphate (apatite and monazite) occurs booth in pure rocks as in laterized

rocks, making materias of economic, ambiental and cientific importance.

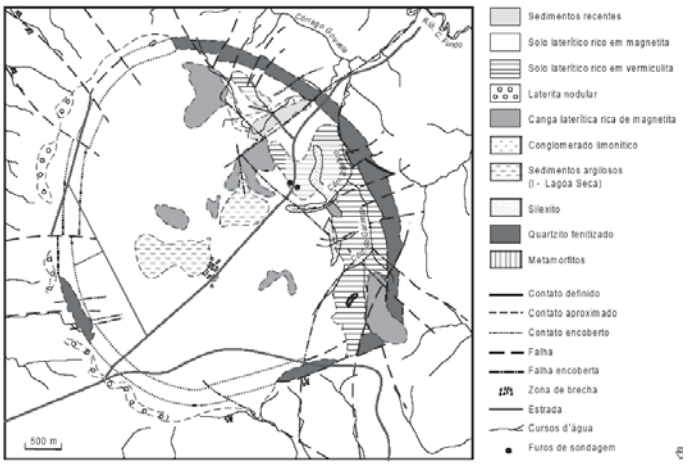


Figure 3: Catalão I alkaline dome superficial litology (Baecler, 1983)

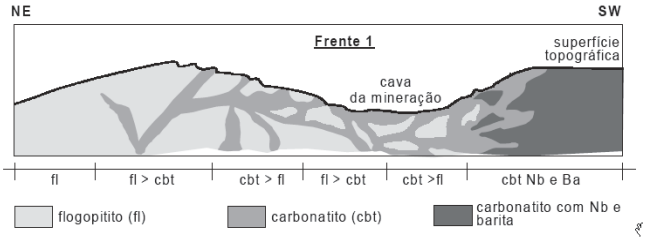


Figure 4: Hypothetic geologic section (Baecler, 1983)

Equipments and Method

The CPRM air survey was flight with a line spacing of 500m (N-S) and a tie line spacing of 5km (E-W). All data reduction was executed by CPRM in 2005.

The equipments used in the gravimetric acquisition were a gravimeter LaCoste&Romberg, G model, 4 analogical altimeters Thommen, 2 digital altimeters air-DB and 2 psicometers Yope.

Were used three fixed altimeters on the base and three mobile altimeters, along with the gravimeter. The three altimeters in the fixed base, were the altitude is know, measure the atmospheric pressure variation wile the other three measures the variation at the stations. By correcting the altimetric data in the stations with the base altimeters it is possible to determinate the altitude in the stations. The average error is 2m, which for this survey is irrelevant.

For the luni-solar correction for gravmetric measures is made by doing a gravimetric measure in a control point were the absolute G is know, one in the beginning of the survey and other in the end.

Data Reduction

The magnetic and radiometric data were reduced by CPRM in 2005.

The gravimetric data were reduced by using the instrumental deviation, dynamic external effects (solid tide, atmospheric variations, etc.), and correlated to the same data base (*Rede Gravimétrica Nacional de Referência do ON e Rede de Nivelamento do IBGE*). The Faye correction and the Bouguer correction were also been done.

After the data reduction a regional gravimetric field is calculated and removed from total gravimetric field, this results in a residual gravimetric field that isolates the gravimetric contribution of the studied body.

Results

After the acquisition and data processing we have the magnetic, gravimetric and radiometric maps for the region.

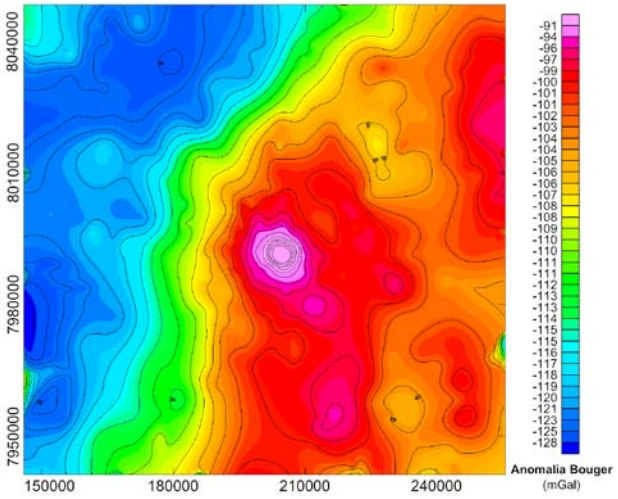


Figure 5: Bouger anomaly map

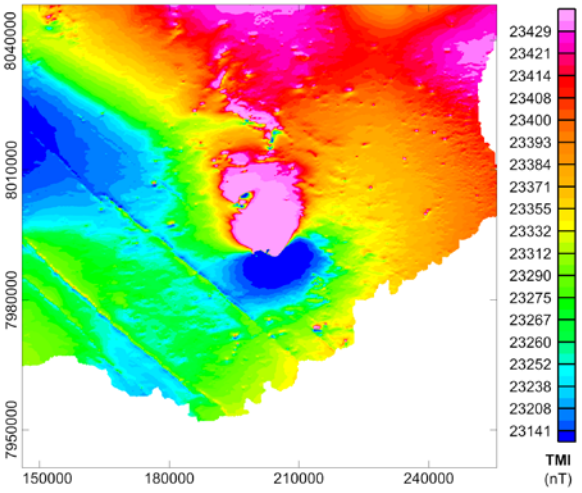


Figure 6: TMI (Total Magnetic Intensity) map

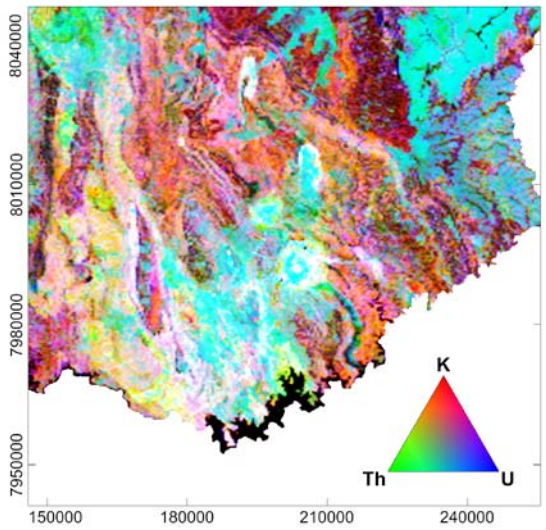


Figure 7: Radiometric Ternary Map

The regional gravimetric field was calculated and extracted from the total field to obtain the gravimetric contribution of the intrusive body.

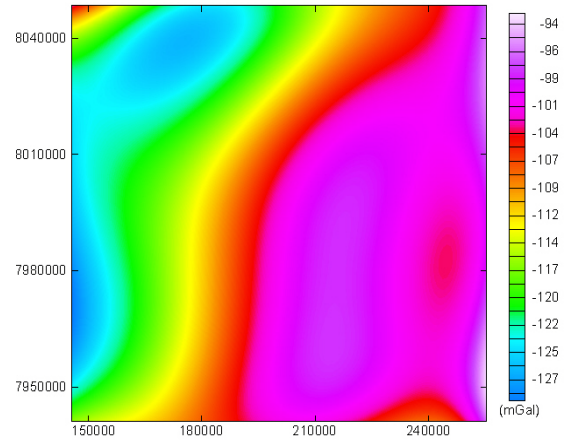


Figure 8: Calculated regional gravimetric field map

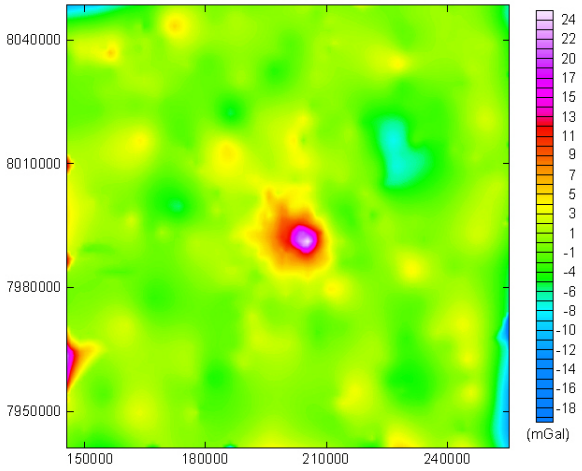


Figure 9: Isolated gravimetric anomaly from regional field map

After isolating the anomaly an A-B profile was traced for a deeper analysis.

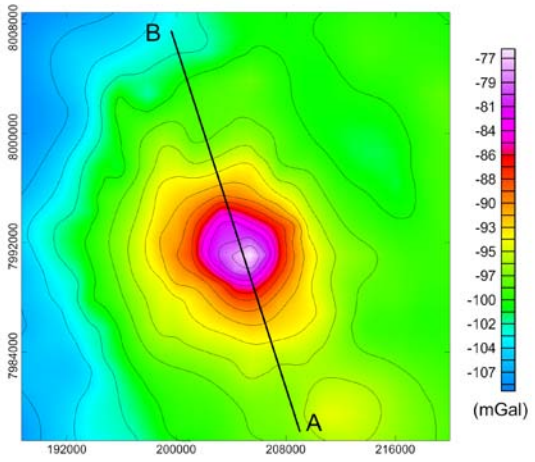


Figure 10: Catalão I isolated anomaly with A-B profile traced

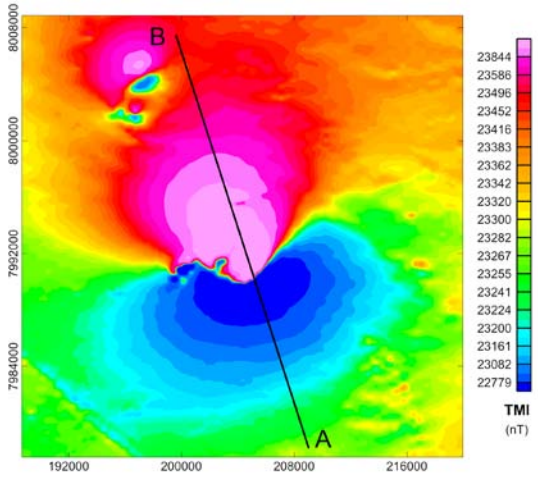


Figure 11*: Catalão* I magnetic anomaly with A-B Profile traced

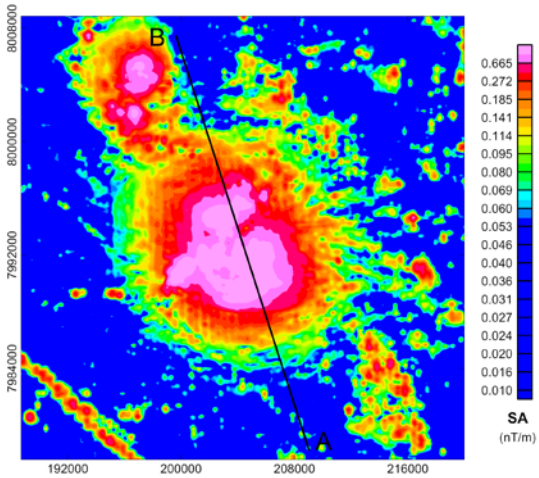


Figure 12: Total Magnetic Field Analytic Signal with A-B profile traced

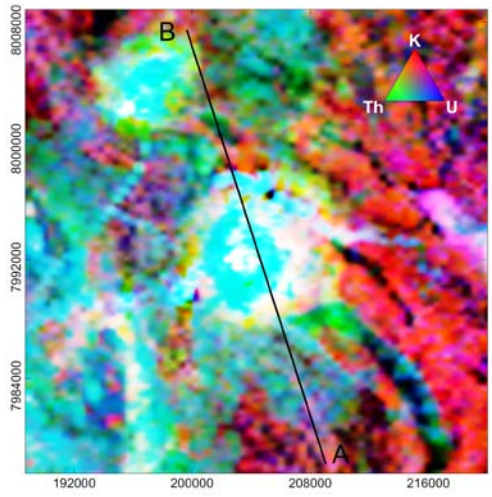
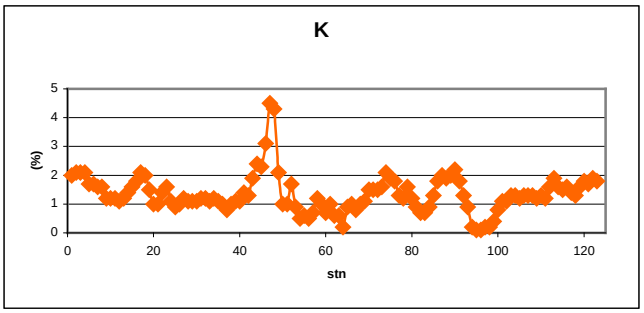
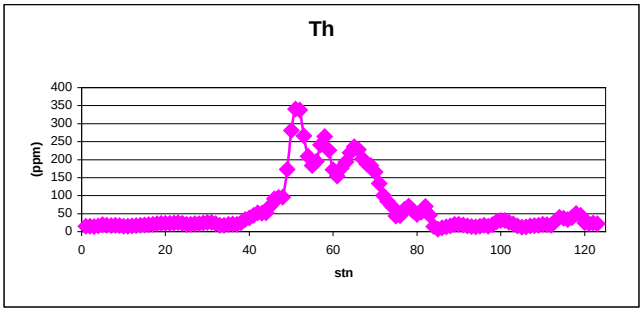
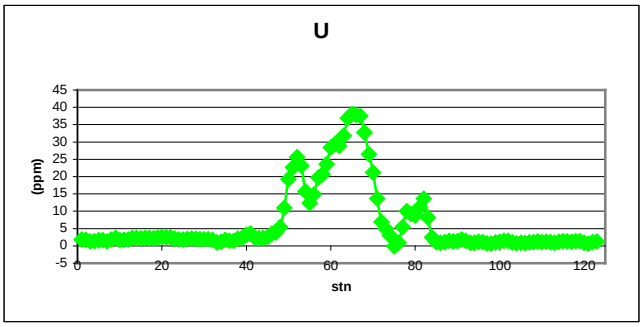


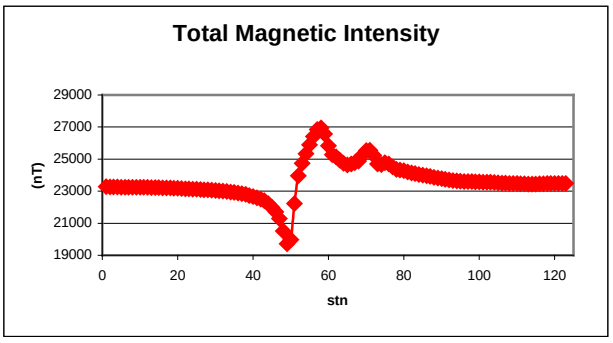
Figure 13: Radiometric ternary distribution with A-B profile traced

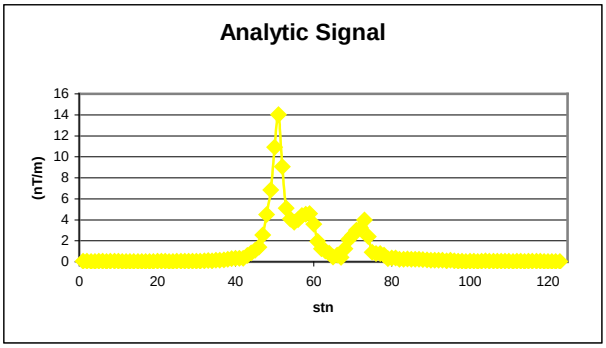
The profile data are bellow.











Conclusions

It's possible to verify the positive gravimetric contribution of the Catalão intrusive body, the residual gravitational about 24mGal stronger then the gravimetric regional field. There is also a internal gravitational variation within the alkaline complex, this occurs because the carbonatitic intrusions in the complex, so if a more detailed survey could have been done will possible to locate the places where the potential for carbonatitic minerals is higher. The intrusion has a strong magnetic anomaly, which indicates a large amount of magnetic minerals in the intrusion. The radiometric signature is typical of the carbonatitic intrusions, with low potassium and high uranium and thorium.

Since there are strong anomalies, both magnetic and gravimetric, it's possible to make a good 3D model, using booth magnetic and the gravimetric data together, to estimate the borders, shape and volume of the intrusive body. This will be done using specific programs for inversion and modeling, this stage will be carried in the second part of the project.

Acknowledgments

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(CNPq), Brazil, the Research Foundation of the State of São Paulo (FAPESP), Brazil and Fosfertil, Brazil.

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