Geophysical characteristics of the Minas Supergroup BIFs and associated minerals in Serro and Conceição do Mato Dentro region, Minas Gerais, Brazil

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Abstract

This work discusses the geophysical characteristics of the Minas Supergroup at Serro and Conceição do Mato Dentro regions in Minas Gerais State, Brazil. The aerogeophysical data processing and interpretation allowed determining magnetic and gamma spectrometric anomaly patterns for that geological unit.

Introduction

The Minas Supergroup outcrops at the Serro and Conceição do Mato Dentro regions, MG, Brazil. Its base is composed by quartzite underlying the phyllites or schists with quartz and mica, and itabirites and banded iron formations (BIFs) on the top. The contacts are tectonic and occur in general as reverse faults (Uhlein, 1991). The banded iron formations and the itabirites are the main source of iron ore in the world. These geological formations are generally associated to strong magnetic responses and remanent magnetization (Gunn & Dentith, 1997).

Aerogeophysical surveys of high resolution using magnetometry and gamma spectrometry at the studied area were held during the years 2000 and 2001. The research was part of the Aerogeophysical Survey Program of the Secretaria de Minas e Energia of Minas Gerais State.

The processing and analysis of the aerogeophysical data allowed for the magnetic and gamma spectrometric characterization of part of the Minas Supergroup area, contributing significantly to the location of new potential areas for iron exploration.

Regional Geological Setting

The surveyed area is the southern portion of the São Francisco Craton and central-south area of the Araçuaí Fold Belt. The main lithostratigraphic units which compose the region are: Guanhães Complex, constituted of gneisses, granitoids and metagranitoids of Archean age, Borrachudos Intrusive Suites composed by granites and granodiorites pre to syn-tectonic of Paleoproterozoic ages; Minas Supergroup composed of schists, phyllites, quartzites and itabirites; Serro volcano-sedimentary sequence; Espinhaço Supergroup and Salinas Complex, composed by metasediments from the Mezoproterozoic; metaultramafic rocks and metabasalts from the Archean (Uhlein, 1991). The geologic map adapted from CPRM (2001) is presented in figure 1.

Data Surveying

The aerogeophysical survey was held over an area of 10,141 km^2 with a linear extension of 49,501 km of aeromagnetic and aerogamma spectrometric profiles. The flight lines were oriented at N30^{o}W with line spacing of 250m and the tie lines were flown at N60^{o}E with line spacing of 2,500m. The navigation was carried on with a DGPS Picodas/Novatel PDAS 1000 system.

The drape flight was held with an average height above the terrain of 100m and average speed of 200 km/h, resulting in one point of magnetic data at each 5.5 meters, and one point of gamma spectrometric data at each 55 meters.

Aeromagnetic data were acquired with a Scintrex CS2 cesium vapor sensor with resolution of 0.001 nT, with a sampling interval of 0.1s. Gamma spectrometric data were acquired with the system Picodas PGAM of 256 spectral channels with two downward NaI(Tl) crystal sets (2048 cubical inches) and two upward crystals (512 cubical inches), with a sampling interval of 1s.

Aerogeophysical data processing

The aeromagnetic data used for this work were corrected for the diurnal variations, parallax errors, drape effects, levelling and the IGRF was removed (SEME, 2001).

The corrections in the gamma spectrometric data used for this work included: filtering (to remove spikes), parallax correction, standard altitude calculation, background removal, stripping and terrain correction.

The magnetic data were interpolated by the minimum curvature method with cell sizes of 50x50 m. Residual Magnetic Field, Analytic Signal and Vertical First Derivative maps were created with this procedure.

Due to the magnetic latitude of the area (-30^o) the Analytic Signal map was used instead of the Residual Magnetic Field reduced to the pole or reduced to the magnetic equator, as these operation could distort some

of the residual magnetic anomalies (MacLeod et al, 1993).

The gamma spectrometric data was interpolated by the minimum curvature method with cell sizes of 100x100 m. The individual channels (U, Th, K) were processed separately and the results are presented as a ternary map of radiolements.

Results and Discussion

The data processing and map interpretations allowed the geophysical characterization of the Minas Supergroup at the area. The main observed geophysical characteristics are listed below.

- The high amplitude and short wavelength elongated magnetic anomalies which occur with, generally at the granite body borders (tectonic contact), are correlated to the banded iron formations and itabirites, as indicated by an arrow at the figure 2.

- These magnetic features are clearly defined at the Analytic Signal map. The strips that can be associated to the Minas Supergroup (white inclined arrows on figure 3) have strong magnetization. The anomalies show a continuous pattern in the Analytic Signal map, and are represented by a series of small localized anomalies in the Residual Magnetic Field map (figure 2), suggesting that they are associated to a shallow source. This interpretation is in agreement with the geological data of Uhlein (1991).

- The other anomalies indicated by arrows in figure 3 show the strong magnetization and the elongated pattern of these anomalies. This pattern is very characteristic of this geological formation type, and similar results can be found associated to the Minas Supergroup at the region of the Rio das Velhas Greenstone Belt (Silva et al., 1999).

- The black arrows in figure 2 indicate magnetic anomalies which exhibit an inversed polarity pattern. This behavior can be assigned to the strong remanent magnetization that is a characteristic of BIFs (Gunn & Dentith, 1997).

- Comparing both the Residual Magnetic Field and the Analytic Signal maps with the geologic map shown at figure 1 one can observe the excellent correlation of these magnetic anomalies with the Minas Supergroup. These geophysical features, however, occur at places where no detailed geological surveys are available, and can be used as indicators for the search of new potential areas for exploration.

- The Ternary Radioelements map (figure 4) essentialy reflects the surface geology. The Minas Supergroup at Serro and Conceição do Mato Dentro regions are well represented by high potassium concentration associated with low uranium and thorium contents. Granitic and Metagranitic bodies are well represented by higher concentrations of the three radioelements. The observed features in Ternary Radioelements map suggest some of the identified units can be not completely represented in the Geologic map.

Conclusion

The processing and interpretation of the aerogeophysical data allowed to identify some characteristics of the Minas Supergroup at Serro and Conceição do Mato Dentro regions in Minas Gerais State, Brazil. The achieved results show the format and amplitude of the magnetic responses of the BIF and Itabirites which occur on this geological formation. In this context, the areas without detailed geological surveys, in which these geophysical characteristics occur, are potentially interesting for mineral exploration.

Acknowledgments

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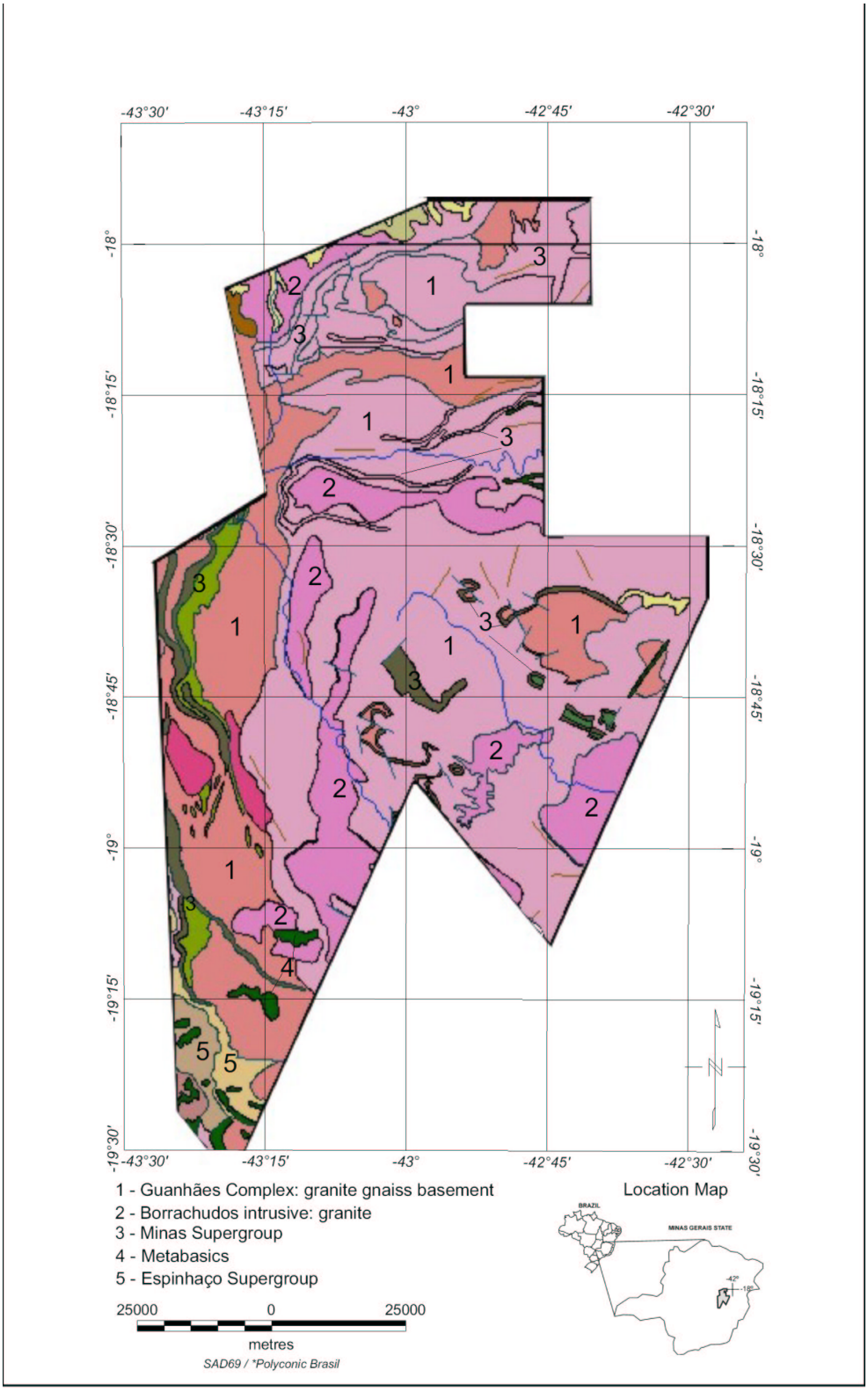

Figure 1: Geologic Map. Source: CPRM (2001).

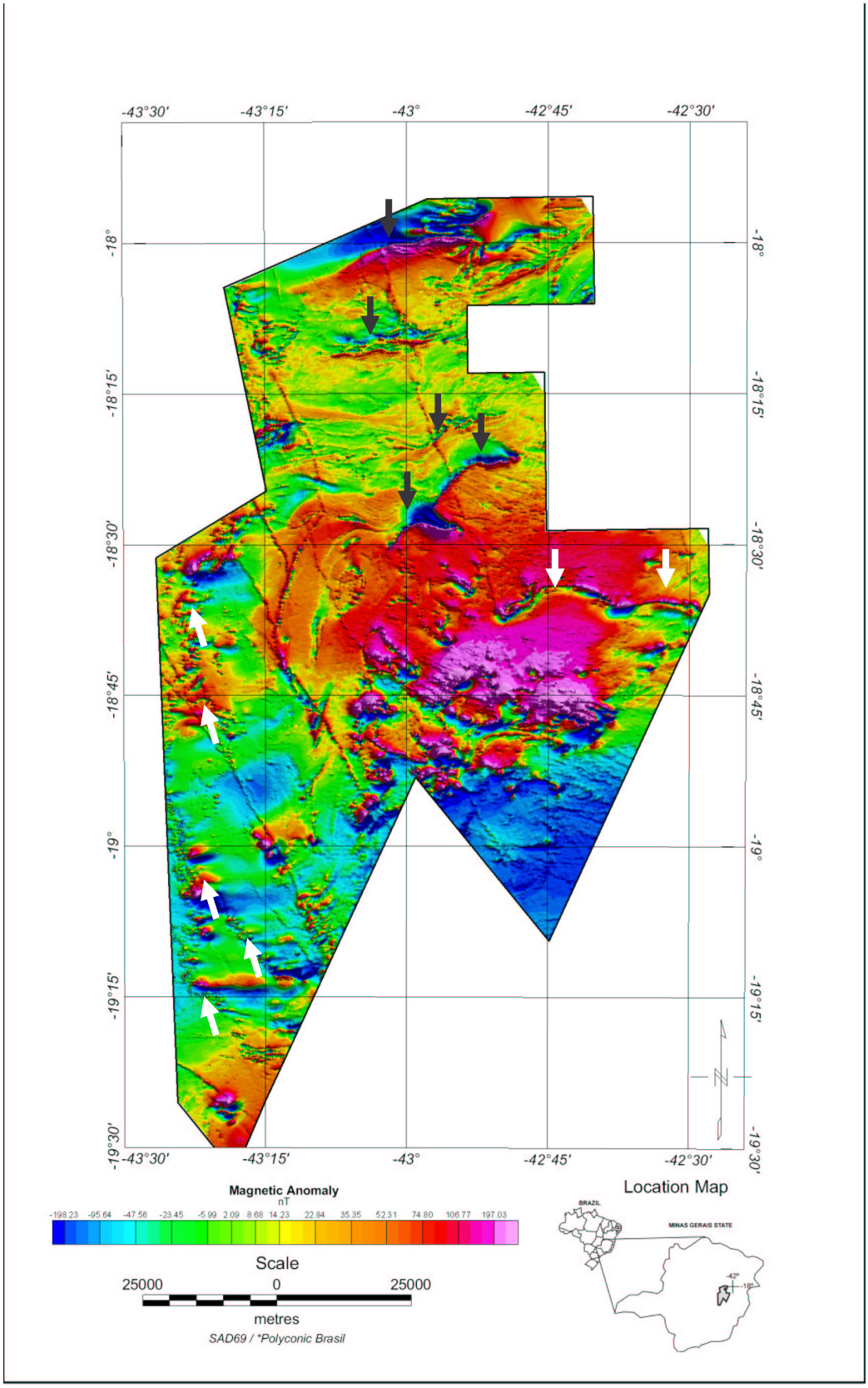

Figure 2: Residual Magnetic Field Map.

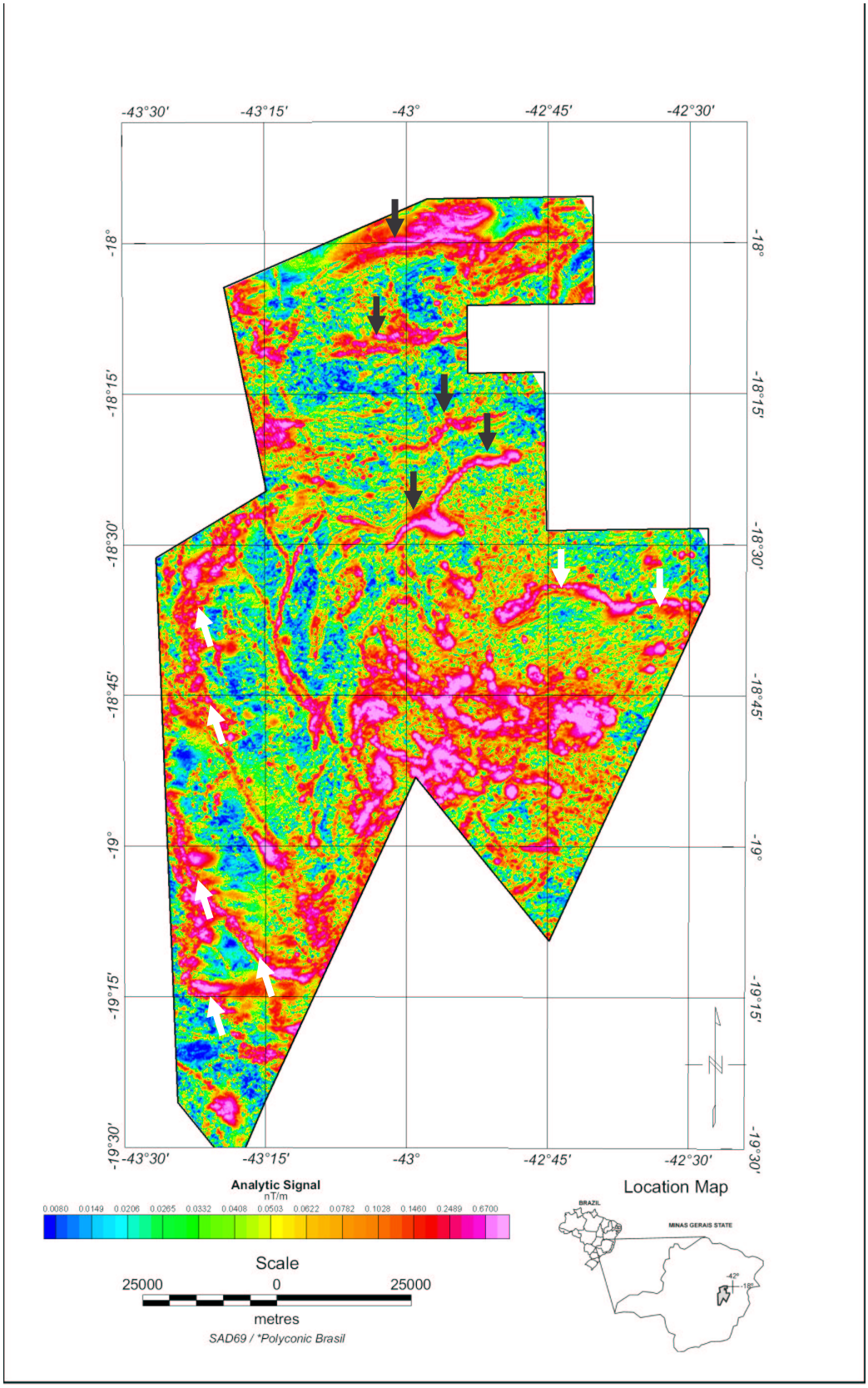

Figure 3: Analytic Signal Map.

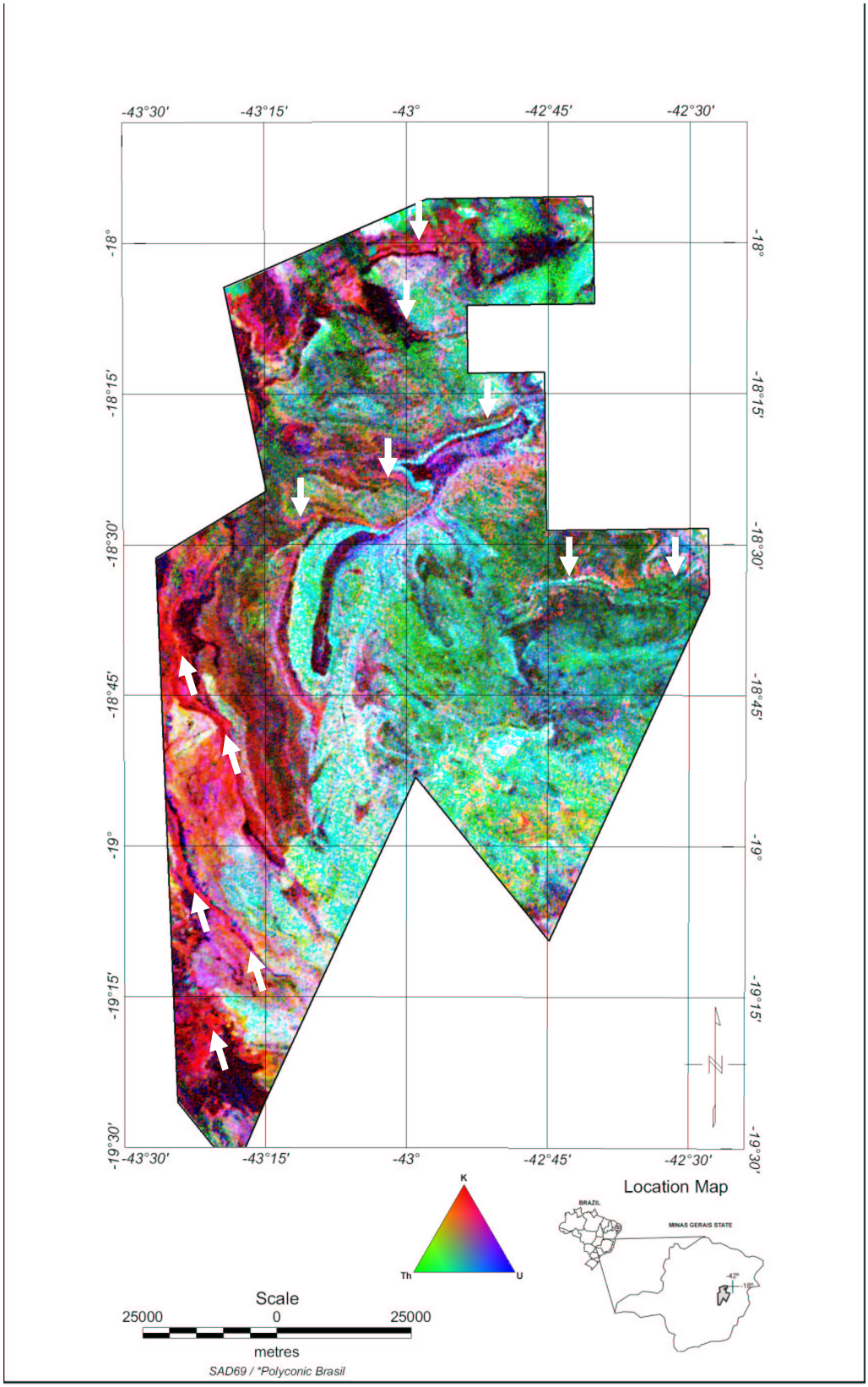

Figure 4: Ternary Radioelements Map.