AEROMAGNETOMETRIC DATA PROCESSING REVEALING EMPLACEMENT HISTORY OF GRANITE COMPLEXES: Lavras do Sul Intrusive Complex and Jaguari Granite Intrusion study case (RS, Brazil)

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Abstract

The Lavras do Sul Intrusive Complex (LSIC) is a shoshonite- to alkaline type intrusion, while Jaguari Granite Intrusion (JGI) shows just alkaline terms. These both intrusions are close together in western part of Sul-riograndense Shield. The aeromagnetic data processing revealed two types of lineaments around both intrusions (LSIC and JGI): i) regional lineaments and ii) intrusion related lineaments; both lineament types represent different shallow magnetic source. Regional magnetic lineaments are related to regional lithologies and deformational structures. Intrusion related lineaments show a circular distribution around both LSIC and JGI; they represent shallow source, positive magnetic anomalies that are caused by different types of mafic dikes: basaltic, lamprophyric and/or kersantitic ones. There are also felsic dikes around both LSIC and JGI, but they are controlled by radial fracture system. As both LSIC and JGI are circumscribed by circular dikes, at some time during the magmatic event, they must have evolved as a single magma chamber. Circular and radial dikes also point to a large caldera structure that must have evolved by multiple collapse episodes. The development of a caldera structure is compatible to a ballooning type emplacement mechanism for LSIC and JGI.

Introduction

Lavras do Sul Intrusive Complex (**LSIC**) and Jaguari Granite Intrusion (**JGI**) are located in the western part of Sul-riograndense Shield (Fig. 01).

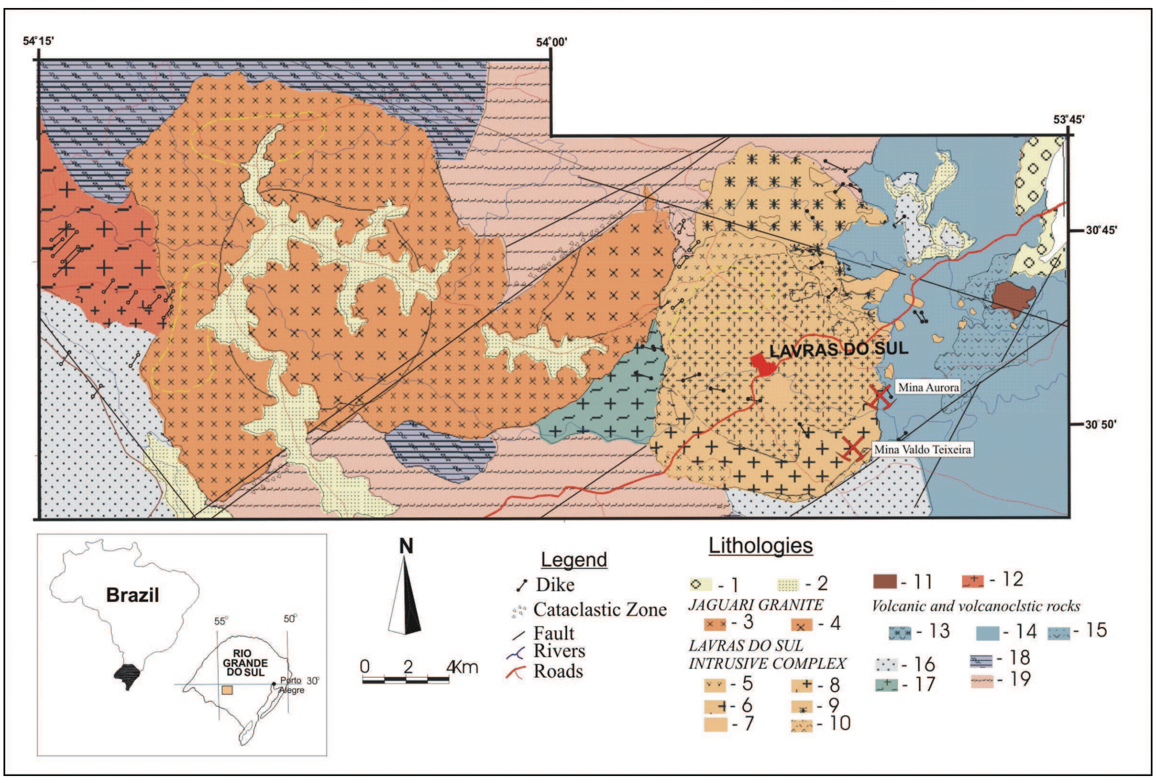

Figure 01 – Geological map of the CILS and JGI (Gastal, 1997). Legend: 1) Santa Bárbara Fm.; 2) Cenozoic and Gondwanic sedimentary cover; 3) Sienogranite; 4) Monzogranite; 5) Pertita granite; 6) Sieno-granite; 7) Porphyric quartz monzonite; 8) Granodiorite to monzogranite; 9) Quartz monzonite and monzonite; 10) Arroio do Jaques ortopirox. bearing monzodiorite; 11) Estrela granite; 12) Santa Rita monzogranite; 13) Latitic flows and breccias; 14) Andesitic flows and pyroclastic rocks; 15) epiclastic rocks; 16) Neoproterozoic cover (Maricá Fm. and Ibaré phylites); 17) Fazenda do Posto granodiorite; 18) Metamorphosed and deformed volcano-sedimentary sequences and mafic-ultramafic complexes; 19) Granite-gneissic complexes (Ortometamorphic Imbicui Suite).

They were characterized, in their actual configuration, by Gastal (1997) and they represent the last magmatic events during the Neoproterozoic orogenic cycle in Mantiqueira Province (RS). The LSIC has shoshonite-to-alkaline magmatic affiliation, while JGI shows just alkaline terms (Gastal, 1997). The LSIC is a multiphase intrusion composed by a range of rock types: from monzodiorite and quartz-monzodiorites, through granodiorite and monzogranites, to sieno and k-feldspar granites; these rock types are arranged in a zoned structure, but mafic rocks are placed in the NNE and northern part of the LSIC (Fig. 01). The JGI, on the other hand, includes just monzogranites and sienogranites (Fig. 01) and has a very poorly developed inner structure. Both intrusions were emplaced into volcano-sedimentary sequences (Palma Volcano-sedimentary Seq., Hilário Fm.) and into granite-gneisses (Cambaí Complex).

The multiphasic nature of LSIC can be pointed out as the reason for lode Au-quartz veins occurrences concentration around it (Andrade *et al*, 1998); it can be seen that JGI has not a multiphase character (Figure 01). General characteristics of the LSIC (shoshonite-to-alkaline granitic intrusion) and the mineralization (ore composition, hydrothermal alteration, etc…) permitted to assign these ore occurrences as related to Climax type intrusions (Andrade *et al*. 1998). But, it is to be realized that LSIC has not any more its root, eroded by subsequent processes.

The aim of this paper is to present some concerns about the emplacement of both, so close, intrusions. These concerns are base mainly on aeromagnetic data processing, but also in new fieldwork data.

Processing of aeromagnetic data

Aeromagnetic data is from Camaquã Airborne Geophysics Project (Jackson *et al.*, 1973) and was gently made available by CPRM (Companhia de Pesquisa de Recursos Minerais). Flight lines are spaced 1000 m apart, and the sampling interval in flight line is 127 m. In the pre-processing of airborne magnetic data, systematical errors were eliminated, such as: heading effects, removing diurnals, navigational effects, time variation in the magnetic field, aircraft effects and ground clearance variation.

Processing of aeromagnetic data included the subsequent steps: (i) statistical analysis of data; (ii) data filtering to eliminate artifacts, (iii) generation of total magnetic intensity map by minimum curvature girding method, and (iv) analytic signal, first vertical derivative over analytic signal filter and AGC filtering with oblique NW-SE illumination (Figure 2). The 1st vertical derivative filter is used to point out short wavelength components (shallow source) and to eliminate deep source effect. AGC filter and oblique illumination were applied to emphasize the amplitude of shallow source signals.

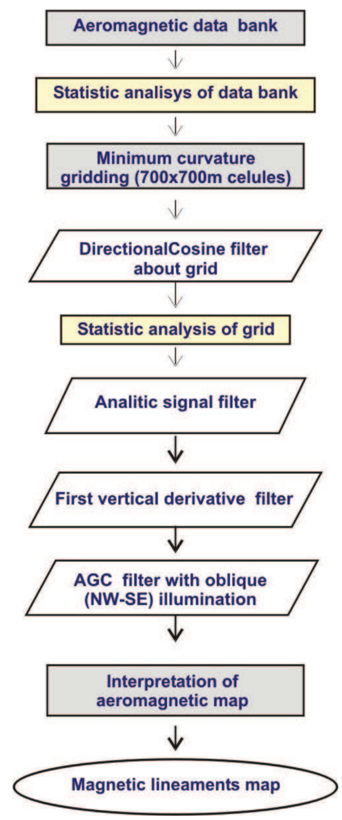

Figure 2 – Procedures applied for processing airborne magnetic data in Lavras do Sul region (RS, Brazil).

Magnetic lineament analysis

The aeromagnetic data processing (1st.vertical derivative and oblique illumination) revealed a series of lineaments around both intrusions (LSIC and JGI). The magnetic lineaments were interpreted in the inflection point from high to low magnetic intensity (Figure 02). The magnetic lineaments around LSIC and JGI can be distinguished into two types: i) regional lineaments (Figure 03) and ii) lineaments related to intrusions (Figure 04). Regional lineaments are related to shallow magnetic source that represent lithologies making up integral part of volcano-sedimentary sequences and/or granite-gneissic complexes were both intrusions were emplaced. Lineaments related to intrusions, on the other hand, circulate both intrusions at same time (Figure 04); these lineaments are also shallow magnetic sources that are interpreted as circular dikes intruded in the country rocks during magmatic events. In this way, lineaments related to intrusions define an elliptical structure that circumscribes both LSIC and JGI.

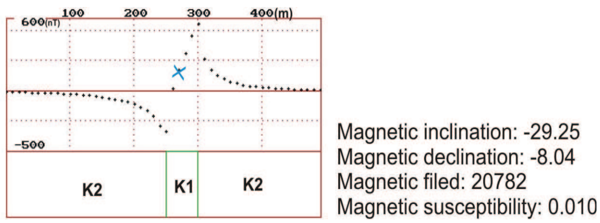

Figure 02 – Definition of inflection point (x) for magnetic lineament interpretation.

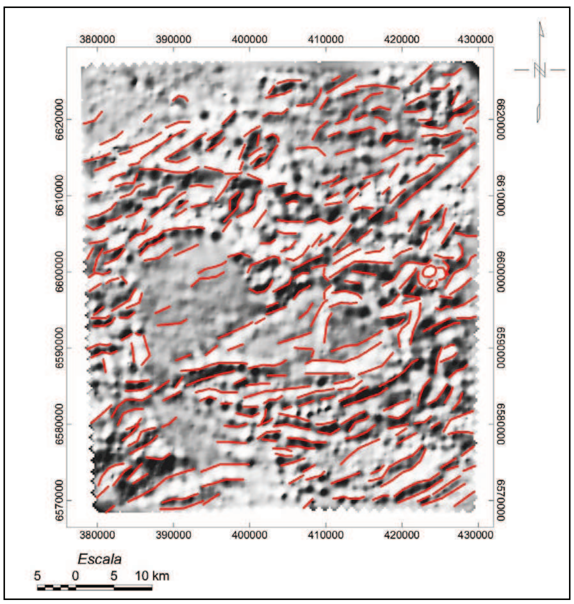

Figure 03 – Regional, shallow source magnetic lineaments interpreted over 1st vertical derivative anomaly map in the Lavras do Sul region (RS, Brazil).

Discussions of magnetic and field data implication for LSIC and JGI emplacement

Fieldwork data sampled after magnetic data processing show that circular lineaments are due to 1-4 m thick mafic dikes. These mafic dikes have basaltic composition (Strieder & d'Ávila, 1985), lamprophyric composition (amphibole bearing mafic dikes; Lima, 1985,1995), or kersantitic composition (phlogopite bearing mafic dikes; Gastal, 1997). These mafic dikes are, then, responsible for high frequency and large amplitude magnetic anomalies revealed by data processing (Figure 04). Fieldwork also showed another group of dikes: dacitic dikes that have porphyries of k-feldspar and amphibole; these dacitic dikes were assigned to Acampamento Velho Fm. magmatism (Strieder and d'Ávila, 1985). However, dacitic dikes are not emplaced in circular structures around both LSIC and JGI, but in radial structures. Dacitic dikes did not produce high spatial frequency anomalies, even under varying direction of illumination. The high frequency and large amplitude magnetic anomalies represent shallow source structures (mafic dikes) displaying circular arrangement to both LSIC and JGI.

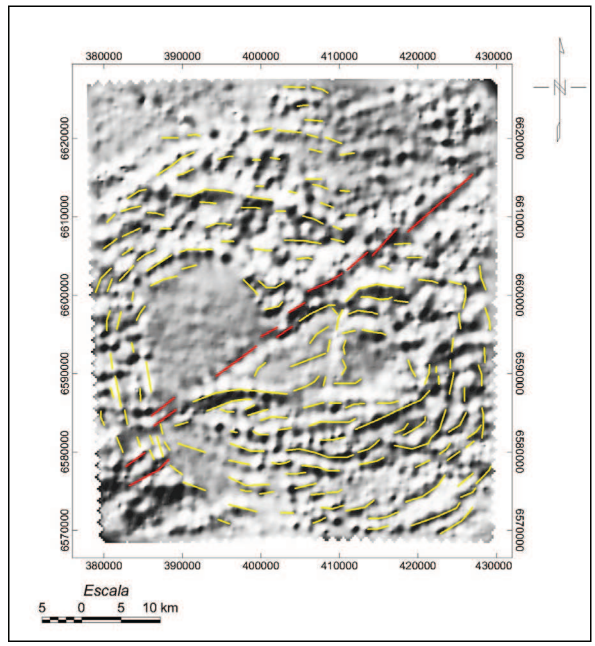

Figure 04 – Magnetic lineaments related to intrusions (LSIC and JGI), interpreted over 1st vertical derivative anomaly map in the Lavras do Sul region (RS, Brazil).

The main implication of the circular dikes circumscribing both LSIC and JGI is that, at some time during their emplacement history, they must have evolved as a single magma chamber. Circular and radial dikes also imply the development of a large caldera structure that must have evolved by multiple collapse episodes, from small (under LSIC) to wider (under LSIC + JGI) fracture sets. The development of a caldera structure is compatible to a ballooning type emplacement mechanism for LSIC and JGI (Roldão et al., 2000). A special geological investigation was designed in the soft meta-sediments of Palma Volcano-sedimentary Sequence to elucidate the emplacement mechanism and its relation to ore occurrences around LSIC and JGI (Roldão and Strieder, in prep.).

Acknowledgments

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