A SYNTHESIS OF THE STRUCTURAL EVOLUTION OF THE PEDRA LAVRADA MINING DISTRICT, SERIDÓ PEGMATITIC PROVINCE, NE BRAZIL

*1Emerson Diego Gomes Sales, 1Lauro Cézar Montefalco de Lira Santos, 1Vandriele Alves Genuíno, 1Fabrício Fernandes Vieira, 2Francisco Wilson Hollanda Vidal

1Universidade Federal de Campina Grande, Unidade Acadêmica de Mineração e Geologia
Av. Aprígio Veloso, 882
Bairro Universitário, Campina Grande – PB
* diegosales45@gmail.com

2Centro de Tecnologia Mineral – CETEM
Av. Pedro Calmon, 900
Cidade Universitária, Rio de Janeiro – RJ
A SYNTHESIS OF THE STRUCTURAL EVOLUTION OF THE PEDRA LAVRADA MINING DISTRICT, SERIDÓ PEGMATITIC PROVINCE, NE BRAZIL

ABSTRACT

The Pedra Lavrada mining district is located in the Paraíba state, NE Brazil. This region is known by the intense exploration of industry minerals such as white mica, potassic feldspar and quartz, which are mainly extracted from pegmatitic rocks. These bodies are part of the Seridó Pegmatitic Province, an area in northeast Brazil that is composed by several pegmatitic intrusions and important mineralizations, such as the famous Paraíba Tourmaline. In the study area, these pegmatites are intrusive in biotite schists and garnet-biotite schists of the Seridó Formation, Seridó Fold Belt. Mesoscopic analysis revealed that this area was subjected to polydeformation including the $D_n$, $D_{n+1}$ and $D_{n+2}$ structural phases. $D_n$ and $D_{n+1}$ has a ductile rheology, which the former represented by tangential tectonites being restricted to Nova Palmeira town region, and the latter associated with vertical tectonites, that represent the main structural framework of the region. Both tectonics control the trend of regional foliation and the shape of most of pegmatitic and granitic rocks of the region. At last, $D_{n+3}$ is ductile-brittle and brittle, and is represented by fractures that are filled or not by pegmatitic and aplitic dykes in the NNW-SSE and E-W directions. Detailed geological mapping revealed that these pegmatites have internal mineral zoning which is typical of heterogeneous pegmatites, besides being controlled by a main NE-SW regional trend. The combination of these data indicates that these pegmatites were emplaced in the continental crust by a transtensive regime, which is related to the Pedra Lavrada and Picuí-João Câmar NE-SW strike-slip shear zones, resulting in the interaction between $D_{n+2}$ and $D_{n+3}$ deformational events.

KEYWORDS

Structural evolution, Seridó Pegmatitic Province, Pedra Lavrada mining district

INTRODUCTION

Granitic pegmatites are well known rocks because they are source of strategic metals to several industry segments, such as Ta, Nb, Be, W and rare-earth elements (Linnen et al., 2012). The Seidó region in northeast Brazil is characterized by a plenty of pegmatite stocks, in which its economic potential is known worldwide for Nb-Ta minerals, common industry minerals such as muscovite and feldspars and important gemstones, including elbaite tourmalines such as the famous Paraíba Tourmaline.

Recently, petrology and gemology-related research has strongly contributed to the knowledge of these pegmatites. Nevertheless, the tectonic setting and the nature of magma emplacement, besides structural relationships with the wall-rocks has not been addressed, except by few regional approaches such as that presented by Araújo et al., (2001).

In this paper we present structural and stratigraphic relationships between the Alto do Feio and Alto da Serra Branca pegmatites and regional wall-rocks and major structures of the area. These pegmatites are part of the Pedra Lavrada mining district, which is fairly important for this region, thus we intend to contribute to future mineral research projects in the region as well as the mining workers of this region.
GEOLOGICAL SETTING

The Pedra Lavrada mining district is located in the southern portion of the Seridó Pegmatitic Province (Santos et al., 2014). This province is inserted in the Seridó Fold-belt of the Rio Grande do Norte Domain (Figure 1), which is located in the northern part of the Neoproterozoic Borborema Province.

Regionally, the Rio Grande do Norte Domain is composed by several sequences of Archean to Paleoproterozoic gneissic and migmatite sequences, including the Rio Piranhas, São José do Campestre and Jaguaripeano terranes. In addition, these terranes are intruded by several Ediacaran-related granitic intrusions (Brito Neves et al., 2000; Santos et al., 2000).

The Seridó Fold-belt is formed by several segments of supracrustal rocks that locally host important Au and W-related deposits and is Neoproterozoic in age (Van Schmus et al., 2003). On a stratigraphic point of view, it is composed by the Jucurutu, Equador and Seridó formations. In the region of the Pedra Lavrada mining district, this unit is mostly composed by biotite-schists and garnet-biotite schists of the Seridó Formation. This formation trends to NE-SW and host several mineralized pegmatitic intrusions including the Roncador, Capoeira, Serraria, Alto Serra Branca and Alto do feio pegmatites.

Figure 1 – Regional geological map of the Borborema Pegmatitic Province and the location of the main pegmatitic bodies, after Beurlen et al., (2014).
STRUCTURAL ANALYSIS OF THE STUDY AREA

This research was conducted combining aerial photographs, Landsat ETM satellite images and mesoscopic field measurements of the main structures that are related to the Pedra Lavrada mining district, including the studied pegmatites. This region is strongly affected by ductile strike-slip shear zones on the NNE-SSW directions, defining the main geological trend of the Rio Grande do Norte Domain as shown by Archanjo et al., (2008).

We defined three main deformation styles, which are called Dn, Dn+1 and Dn+2. The Dn deformation is marked by structural elements that are concentrated in the NE portion of the area, being defined by a series of mylonitic and schistosity planes. In the vicinity of the Nova Palmeira town, is common the presence of low-angle foliation with E-SE direction. Other associated structures include open and closed Fn folds which vertical and sub-vertical axial planes or overturned ones. Kinematic markers which are easily observed in the XZ plane of the deformation ellipsoid are mainly represented by asymmetric folded micas and deformed quartz and potassic feldspar porphyroclasts (σ type), which suggest up-dip tectonic vergence to WNW (Figure 5a).

On the other hand, Dn+1 deformation corresponds to the most important structural regime, being responsible by the mainly trend of the region. This deformation determines the elongated shape of the rocks in a preferentially NNE-SSW trending, formed by planar S-L type tectonites. The main associated structural markers include gneissic banding which is vertical associated with an important stretching lineation which is mainly horizontal or forming axial lines in related overturned folds (Ln+1b).

The main associated structures related to this deformation include the dextral Pedra Lavrada and Picuí João Câmara strike-slip shear zones. In outcrops, there are several kinematic criteria that can be easily observed including S-C and asymmetric folded foliation as a consequence of a non coaxial structural regime. The asymmetric shapes of the main mineralized pegmatites of this district are attributed to this vertical regional foliation.

The last identified tectonic regime is the Dn+2 stage is strongly important for mineralization control in the area. It is characterized by the changing in rheologic regime from a ductile brittle. Several faults and joints are observed in schists and intrusive pegmatites, that can be sub-vertical and horizontal. We mapped three main families of fractures related to this stage, which has NNW-SSE, E-W and NE-SW directions. These structures cross-cut the main pegmatites and are frequently responsible for the concentration of ore minerals, such as elbaite tourmaline, cassiterite and amblygonite, besides punctual gemstones occurrences such as beryl.

These phases are commonly concentrated in quartz veins, aplitic dykes and later pegmatitic dykes in directions related to the main mapped families. The geological mapping of these fractures represents an important contribution for prospective works for economic minerals in the area.
Figure 2 – Geological map of the Pedra Lavrada mining district.
DISCUSSIONS AND CONCLUSIONS

Our study aims to demonstrate the main structural elements and evolution of deformation in the Pedra Lavrada mining district, an important region of mineral resources and exploration in NE Brazil. This district is inserted in the Seridó Pegmatitic Province, which concentrates several mineralized pegmatites of NE Brazil, being a strategic region for industry minerals in Brazil.

This region is affected by at least three distinct structural events which are called Dn, Dn+1 and Dn+. Dn event is responsible by the development of a low angle dipping foliation associated with high rake lineation that dips to SE. This deformation is concentrated in the NE portion of the area affecting mainly the wall-rocks of the mineralized pegmatites, which are mainly schists. This stage can be correlated to a huge thrusting event described in the Seridó Fold-Belt by Hackspacher et al., (1993) during the Brasiliano orogeny.

On the other hand, Dn+2 deformation produced the most prominent structures, which are related to vertical mylonites that can gentle dip to SE or NW and are always associated with horizontal lineation.
with low pitches. This deformation is mainly non coaxial and is represented by the transcurrent dextral Picuí-João Câmara and Nova Palmeira shear zones. In addition, it strongly control the elongated form of the Alto do Feio and Alto Serra Branca mineralized pegmatites.

At last Dn+2 deformation is brittle and is characterized by faults, fractures and joints that cross-cut all the study area. These structures can be mapped in three main families, which follows three main structural trends, which are: NNE-SSE, E-W and NE-SW. They can be sterile or contain important ore minerals, such as elbaite tourmalines, gemstones, cassiterite, amblygonite, among others. Usually, the main ore stages are concentrated in aplite, quartz and pegmatitic veins and dykes.

The strong structural control on pegmatites of the Seridó Pegmatitic province and its mineralizations was shown by Agrawal (1992) and Araújo et al., (2001), who defined the main stages of pegmatites emplacement in the region. In general, our data suggest that these pegmatitic bodies were injected in continental crust through a transtensive tectonic regime. In this sense, the definition of main structural stages in the region shall represent an important contribution to understand the geological evolution of the Pedra Lavrada mining district.

ACKNOWLEDGEMENTS

The authors thanks the Centro de Tecnologia Mineral (CETEM) for funding the development of this research in a cooperation program with Universidade Federal de Campina Grande.

REFERENCES


