ELEVATED ZINC CONTENTS IN ELBAITES FROM PEGMATITES OF THE BORBOREMA PEGMATITE PROVINCE, NE BRAZIL

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INTRODUCTION

The Borborema Pegmatite Province (BPP), NE Brazil, is historically important for tantalum ore, beryl, and minerals for the cheramics industry. It was also well known for a small production of gems, including aquamarine, morganite and common elbaitic tourmaline. More recently, it became famous worldwide for the production of the elbaite known by the fashion name of "Paraíba Tourmaline". The chemical composition of tourmaline-group minerals in the BPP was studied in several occurrences of the BPP, among others by Henn and Bank (1990), Adusumilli et al.(1994), Ferreira et al. (2005) and Soares et al.(2008).

The Y site of elbaitic tourmaline is occupied dominantly by Li (up to1.5 apfu) and Al (up to 1.5 apfu), and minor contents of Fe^{2+}, Fe^{3+}, Mn, Mg, Ti, etc and rarely Zn, which. usually occurs only as a trace element. Therefore three occurrences of elbaite in the BPP are described because of their unusual elevated zinc contents.

GEOLOGICAL SETTING

The Borborema Pegmatite Province (BPP) extends over an area of approximately 75 x 150 Km in the eastern-southeastern part of the Seridó Foldbelt in the Northern Domain of the Borborema Tectonic Province. The Seridó Foldbelt is composed of a Paleoproterozoic gneissic-granitic-migmatitic basement and a Neoproterozoic supracrustal meta-volcano-sedimentary sequence (the Seridó Group) which comprises, from base to top, gneisses and marbles (Jucurutu Formation), quartzites and meta-conglomerates (Equador Formation) and garnet-cordierite-sillimanite schists (Seridó Formation). Several Neoproterozoic granite types are found intruding the Seridó Group. The youngest one is the most probable source of the pegmatites of the BPP and consists of several small pegmatitic granite intrusions with peraluminous, S-type characteristics, with age determinations between 480 and 530 Ma (Soares et al. 2008).

CHEMICAL VARIATION OF Zn CONTENTS IN TOURMALINE

The maximum Zn enrichment in tourmalines according to the classical literature on the subject occurs in the intermediate stage of pegmatite crystallization. Tindle et al. (2002) described Zn-rich schorl (up to 1,28 wt. % = 0,158 apfu), and observed the decrease of Zn with Li enrichment in Pakeagama Lake pegmatite (Canada), and concluded that tourmaline of the exo-

contact and replacement bodies are usually depleted in Zn.

The maximum Zn enrichment in the Mina do Cruzeiro/MG pegmatite (of the Eastern Brazilian Pegmatite Province was observed in elbaites and can occur in different units in a pegamatite: 1.957wt.% Zn were observed in the inner intermediate zone of the vein 1, and 0,577wt% in the wall zone of vein 3 (César Mendes, 1995). High Zn contents can occur in common elbaites (cited authors), and in fluor-elbaites (McCracken, 2002).

The great majority of the elbaite data from the BPP, including "Paraíba Tourmaline" reveal low Zn contents (0.01 to 0.26 wt. % ZnO according to Rossman et al., 1991; 0.0 to 0.50 wt. % ZnO according to Shigley et al. 2001). High Zn content in tourmaline, such as mentioned by Adusumilli et al. (1994), Soares (2004) and Ferreira et al. (2005) in BBP are exceptional. According to these authors (Table 1) Zn contents are:

Table 1 – Data of Zn-rich elbaites from BPP according to 1)Adusumilli et al. 1994 2) Soares 2004; 3) Ferreira et al. 2005

Pegmatite/ Localization	ZnO content, wt.%/ apfu	Pegmatite unit	Wallrocks	Reference	Tourmaline
Gregório/ \Nr 1 in Fig 1	2.15/ 0.223	Wall Zone	Biotite schists	1	Elbaite
Boqueirão/ \Nr 2 in Fig 1	2.43 /0.288	Replacement body	Metaconglomerates	2	Elbaite
Alto Quixaba/ \Nr 3 in Fig 1Frei Martinho-PB	3.01 /0.349	Replacement body	Biotite schists	3	Elbaite

According to the data in Table 1, Zn-rich elbaites occur in pegmatites hosted in several litologies, and in several units of the pegmatites. The analytical data according to Adusumilli et al. 1994, Soares 2004 and Ferreira et al. 2005 (Table 2) show that Zn-rich elbaites generally have low Cu content, low to medium vacancy in X site (0.15 to 0.34 apfu) and high Fe contents.

Table 2 – Cations distributed by structural sites of studied elbaites from BPP, based on 31 (O,OH,F)

Sites →	X				Y								Z	B	W		
Pegmatite	Na	Ca	K	Vac	Al	Li	Ti	Fe2+	Mg	Mn	Zn	Cu	Al	B	OH	F	Cl
Gregório	0,708	0,036	0,004	0,252	1,155	0,859	0,036	0,200	0,338	0,189	0,223	---	6,000	3,000	4,000	---	---
Boqueirão	0,651	0,002	0,009	0,338	1,162	0,778	0,000	0,592	0,010	0,169	0,288	0,001	6,000	3,000	3,756	0,244	---
A. Quixaba	0,833	0,022	0,000	0,145	1,091	1,051	0,013	0,368	0,000	0,128	0,349	0,000	6,000	3,000	4,000	---	---

CONCLUSIONS

The Zn enrichment in elbaites does not occur only in the intermediate stage of pegmatite crystallization, as cited by Jolliff et al. (1986) and Tindle et al (2002), but also later stages of crystallization in pegmatites of various fractionation degrees (medium to high), proved by geochemistry of other mineral phases. This apparently erratic behavior of Zn content in tourmalines contraindicates the attempt of its use as an indicator of pegmatite fractionation degree.

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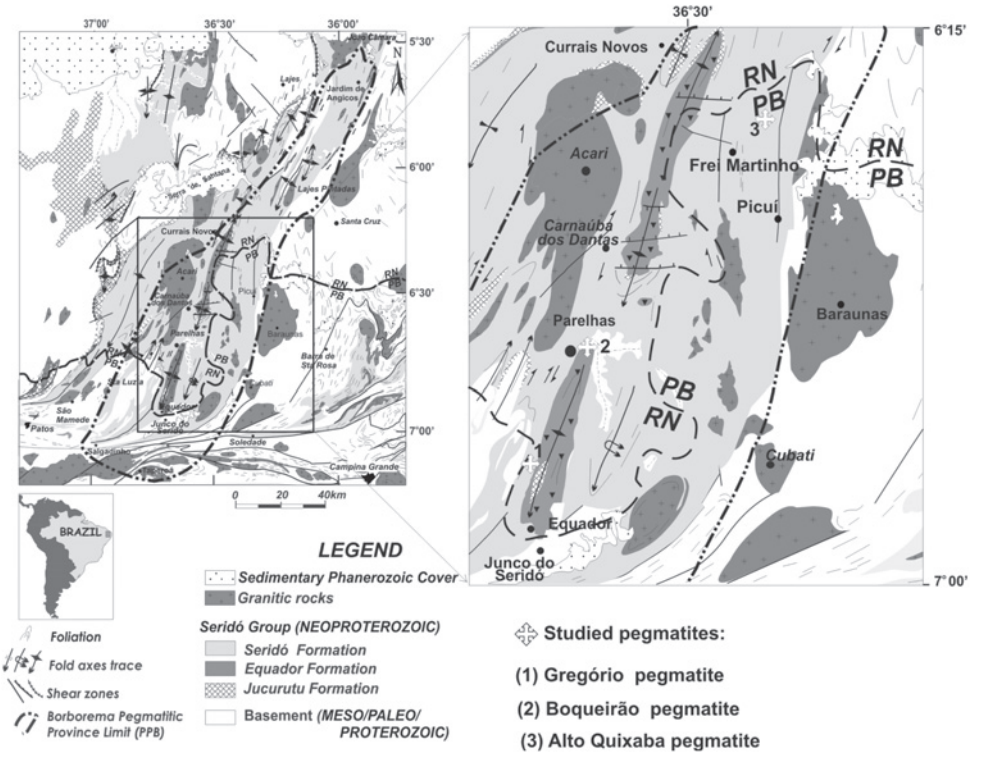

Figure 1 – Simplified geological map of Borborema Pegmatite Province (BPP) and the location of the pegmatites referred in the text