Characterization of ceramic pegmatites raw material from Rio Grande do Norte, Brazil

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Pegmatite, ceramic, geological mapping, physical characterization

Abstract

The Serido Region, in Rio Grande do Norte (Brazil) presents pegmatites which contain several minerals of high interest, like feldspar, kaolinite, tantalite, columbite, etc. In this work, a geological, physical and chemical study of pegmatites from this region is presented. X-ray diffraction, particle size analysis, and chemical and geological characterization were carried out. The results and a discussion of their several uses are presented herein.

Introduction

Pegmatites are important suppliers of several industrial minerals, like quartz, kaolin, feldspars, and rare chemical elements (Li, Ta, Nb, Ga, Yb, etc.). These minerals and elements are used in important branch industries as optical fibers, electronic circuits, satellites, medical, batteries among others. Thus, it is very important to know the location and composition of mines, to account for the variation of physical and chemical properties, which could decrease product quality.

Rio Grande do Norte (RN), in northeastern Brazil, is mineral-rich, but these are sub-explored, because the regional consumer market needs just some specific minerals (feldspars, kaolin, shealite, mainly). So, the study of these mines is of the highest importance, linked to fact that RN is one of the poorest states of Brazil.

This work intends to make a geological and mineral mapping of RN, accompanied by a physical-chemical characterization of the principal materials, to indicate their main industrial applications.

Experimental Procedure

A geological map of the Serido region was traced at a scale of 1/500. Special attention was given to industrial minerals, aiming to determine the geological characteristics and reserves of these minerals, for future applications by the several branches of the ceramic industry.

Remote sensing, using multi-spectral images from satellites and air pictures supplied a geological map, where the main bodies were classified according to their geographic location, dimension and geological profile. The pegmatites were then studied by X-ray diffraction, particle size distribution and chemical analysis.

Results and discussion

The principal result from the geological studies is the mineral map of the Serido region (Fig. 1), where the principal mines can be seen.

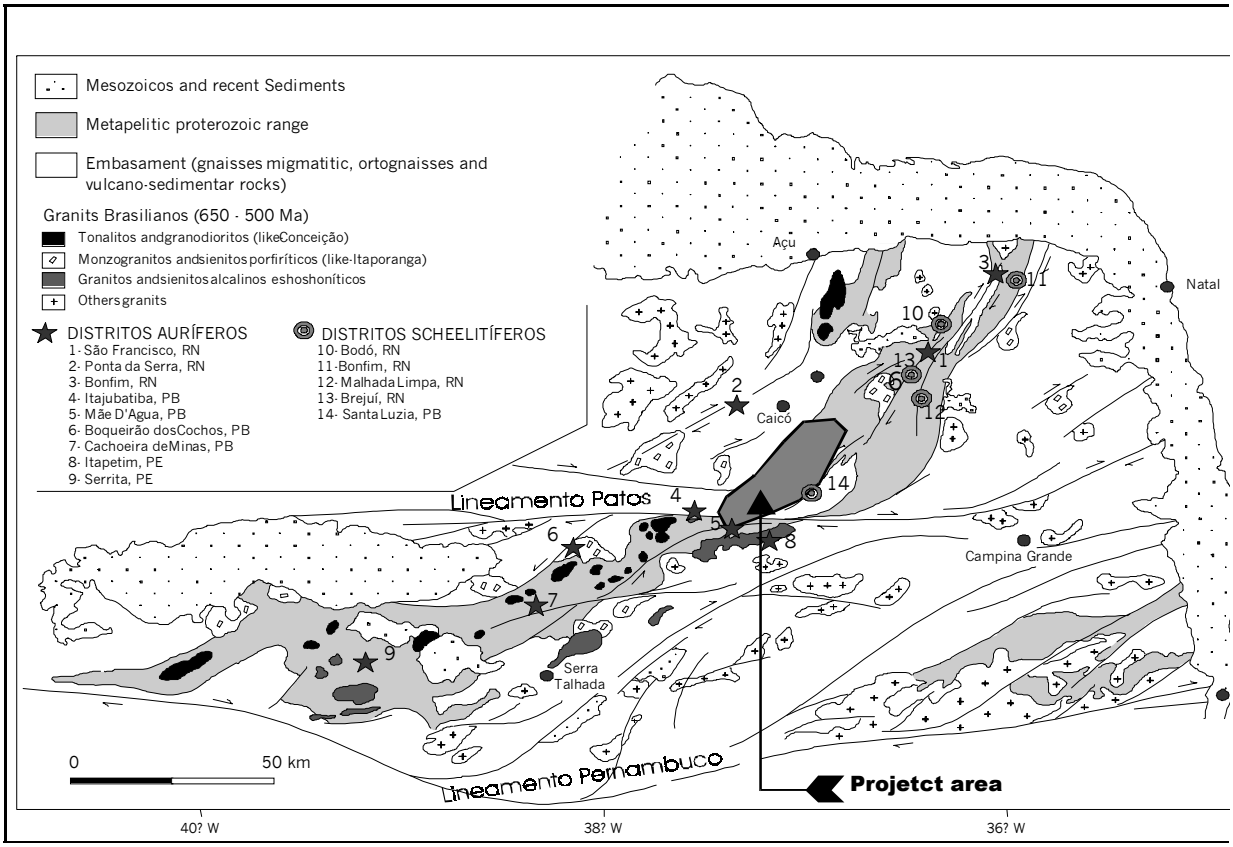

Fig.1 - Pegmatite Mapping of RN

The pegmatites of Rio Grande do Norte presents a mineralogical granitic composition (potassic feldspar, albite, quartz and moscovite).
The pegmatites of Rio Grande do Norte can be roughly classified into two classes:

i) ***Structurally simple Pegmatites*****,** poorly different;

ii) ***Structurally complex Pegmatites*****,** very different;

Two different types of pegmatite bodies can be observed:

i) Homogeneous type: Bodies sterile for metallic mineralizations and, in general, with north-south orientation; they have tabular shape with several hundred meters and 1 to 3 meters wide; they show regular distribution of their essential minerals (quartz, feldspars and micas); feldspars show growing graphical and moscovite occurs at rock contact. When present, mineralizations are disseminated and are Ta - Nb, Be, Li, etc..

ii) Heterogeneous type: Ellipsoidal bodies, with 600m maximum size and width not superior to 150 m; their essential minerals have irregular distribution. They are usually composed of four zones, with symmetrical distribution around the pegmatite body center. From contact with the center body the following zones can be found:

a) Zone I: Thickness is commonly less than one meter. Show large concentrations of moscovite, usually with great dimensions; The mica crystals are perpendicular to rock contact and associated to quartz and feldspars. The most common supplementary minerals are black turmaline, cassiterite and sometimes granades.
b) Zone II: Similar, at grin, texture and composition, to homogeneous pegmatite and have the greatest volume of pegmatitic body, so can be mistaked with homogeneous pegmatite. When the feldspatos grain growth, this zone para a zona III;
c) Zone III: Mainly large potassic feldspate crystals weighting tons.. At this zone are found most of beriles, tantalites and other minerals;
d) Zone IV: Known as quartz nucleous, this zone usually forms the pegmatitic body center, being characterized by existence of large masses of quartz. In this zone we usually found berile;

From dates of tables 1, 2 and 3, we conclude that quartz can be used to make iron alloys (silicon and iron-silicon) and white refractory ceramic. Nevertheless, quartz from Macilon/Vilani and Capoeira pegmatites can not be used to glass manufacturing, because they have high quantities of aluminum. However, they are the only ones that can be used to lamp manufacturing, because have low loss on ignition.

Table 1: Chemical analysis (weight %) of quartz from selected pegmatites of RN

Pegmatite	**Macilon/Vilani**	**Capoeira**	**Salgadinho**	**Redondo**	**Ubaeira**
SiO_2	99.24	99.23	99.21	99.22	99.44
TiO_2	0.10	0.10	0.10	< 0.05	< 0.05
Al_2O_3	0.47	0.47	0.24	0.24	0.19
Fe_2O_3	< 0.05	< 0.05	0.07	< 0.05	< 0.05
MgO	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
CaO	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Na_2O	0.00	0.00	0.00	0.00	0.00
K_2O	0.00	0.00	0.00	0.00	0.00
Loss on ignition	0.21	0.22	0.28	0.29	0.27
Total	**100.17**	**100.17**	**100.00**	**99.95**	**100.10**

Analysis: CPRM (LAMIN and SECLAB-RE)

Table 2: Chemical analysis (wt. %) of feldspars from selected pegmatites of RN

	Feldspars					
Pegmatite	**Salgadinho**	**Capoeira**	**Gamenho**	**Redondo**	**Caraibeira**	**Berile mine**
SiO_2	64.63	64.93	63.41	62.61	64.15	64.11
TiO_2	<0.05	<0.05	<0.05	< 0.05	< 0.05	<0.05
Al_2O_3	18.71	18.21	19.83	18.91	18.91	18.13
Fe_2O_3	< 0.05	< 0.05	0.09	< 0.05	< 0.05	< 0.05

MgO	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
CaO	0.07	0.14	0.07	< 0.05	< 0.05	< 0.05
Na_2O	2.44	3.82	3.23	2.22	3.52	3.09
K_2O	13.33	12.12	11.64	13.63	12.13	13.34
P_2O_5	0.85	0.32	1.30	1.40	0.86	0.15
Loss on ignition	0.50	0.50	0.30	0.60	0.50	0.60
Total	**100.68**	**100.19**	**99.97**	**99.52**	**100.27**	**99.62**

Table 3: Chemical analysis (wt. %) of kaolin from selected pegmatites of RN

	kaolin	
Pegmatite	**Alto do Giz (a)**	**Alto do Giz (b)**
SiO_2	46.22	46.24
TiO_2	< 0.05	< 0.05
Al_2O_3	38.73	38.74
Fe_2O_3	0.11	0.13
MgO	0.05	0.07
CaO	0.07	0.07
Na_2O	0.15	0.15
K_2O	0.07	0.12
Loss on ignition	14.43	14.42
Total	**99.88**	**99.99**

Analyzed by CPRM (LAMIN and SECLAB-RE)

Table 2a: Technological analysis of kaolin from selected pegmatites.

Pegmatite	**pH**	**Alvura (%)**	**Sieve ABNT (no.)**	**Retained material (%)**	**% Accumulated**	**Yield (%)**
			50	1.65	1.65	98.35
	4.7	89.4	100	0.37	2.02	97.98
			200	0.41	2.43	97.57
			325	0.99	3.42	96.58
Alto do Giz (VCR-09B)	Temperature (^oC)	Linear Shrinkage	Flexural strength (Kgf/cm^2)	Apparent Porosity (%)	Specific mass (g/cm^3)	Water absorption (%)
	110	-1.3	11	-	-	-
	950	4.6	42	37.2	1.67	22.3
	1250	7.7	65	32.2	1.86	17.3
	1450	13.8	152	16.1	2.3	7

Analyzed by CPRM (LAMIN and SECLAB-RE)

In figures 2 and 3 we can see typical X-ray and laser granulometry of the pegmatites. These graphics allied to chemical analysis ratify the anterior conclusions about pegmatites uses.

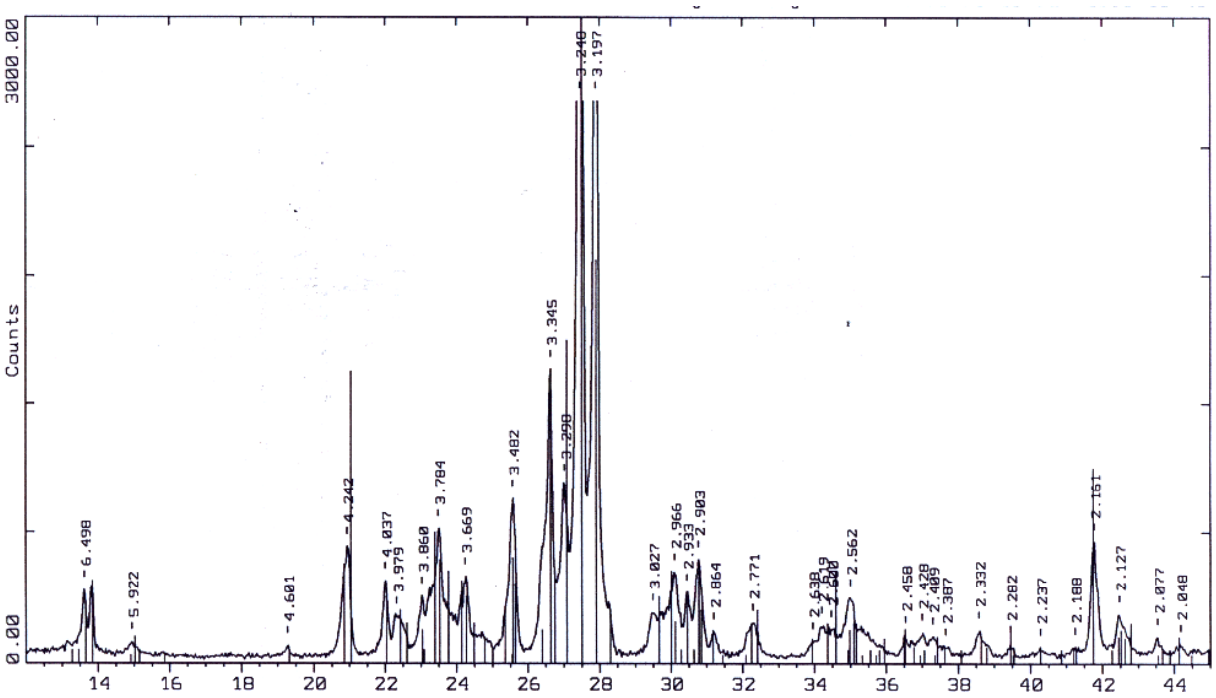

Fig. 1 - Typical X-ray diffracton pattern of pegmatites

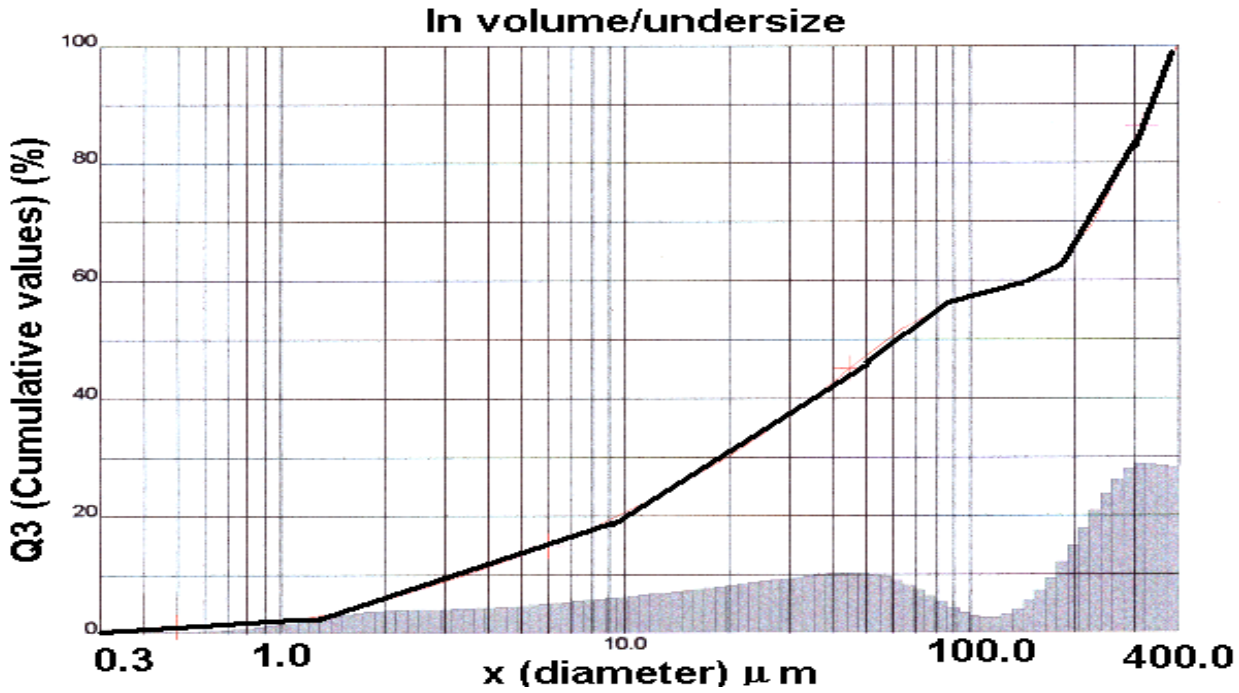

Fig. 2 - Typical particle size distribution curve for pegmatites

Conclusions

- The mineral/geological map of RN shows the principal location and composition of mines;
- From tables 12 to 19 the following observations can be made:

a) The feldspars from selected pegmatites of Rio Grande do Norte can be used as:

Sanitaryware materials, common and green glasses: all samples;
Special glasses and crystals: all samples, except those from Carnaubinha and Xique-xique;
Porcelain and enamels: Only samples from Malhada Vermelha and Alagamar;

b) The kaolin from selected pegmatites of Rio Grande do Norte can be used as:

Load for the pulp and paper industry;
Sanitaryware and refractory ceramic;

References

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