COMPOSITIONAL VARIATION OF THE CORUMBATAÍ FORMATION AND MINE LOCATIONS IN THE CERAMIC POLE OF SANTA GERTRUDES – BRAZIL

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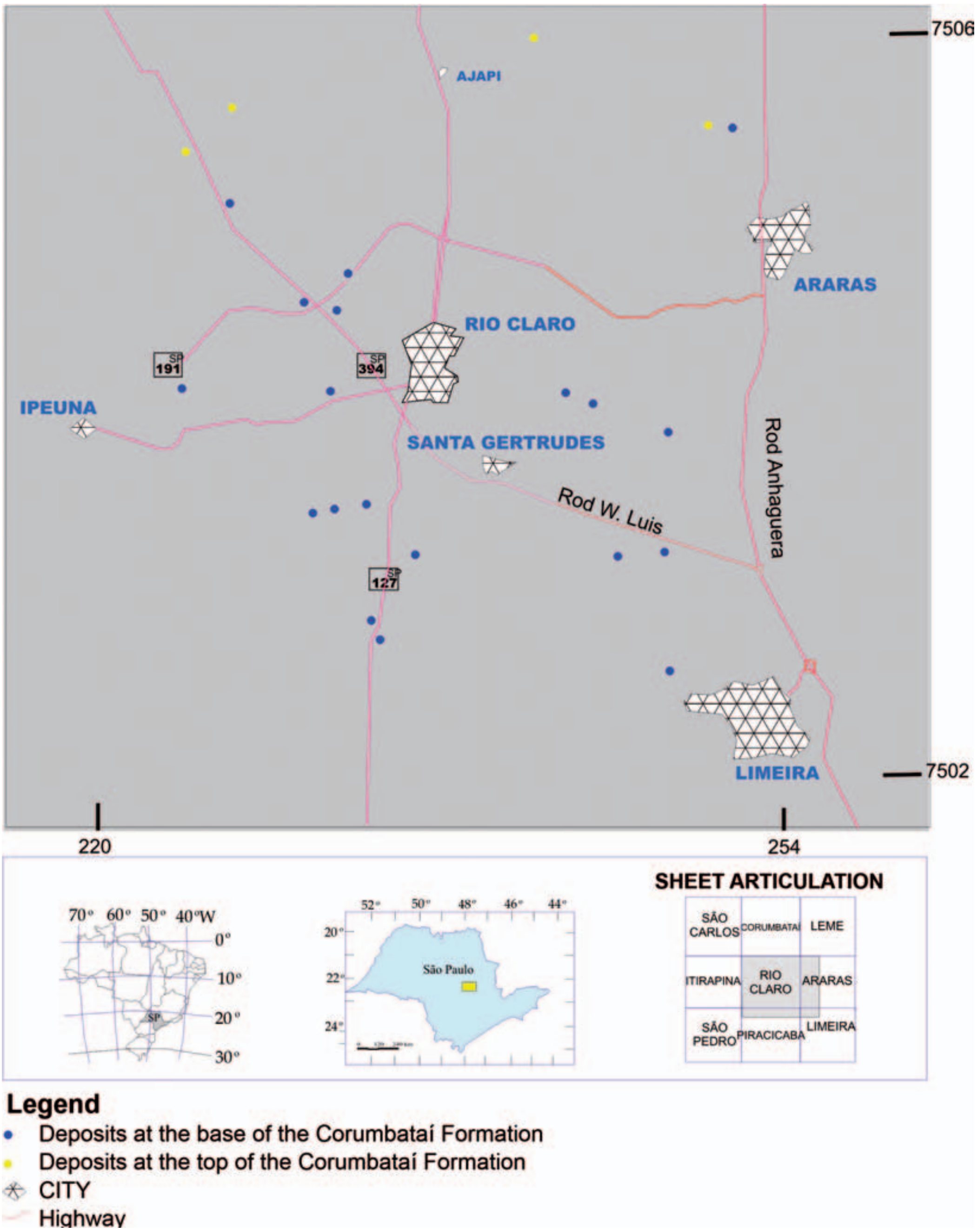
The ceramic pole of Santa Gertrudes located in the interior of the State of São Paulo, Southeast Brazil, has about 20 deposits currently operating, and several others paralysed because of environmental, legal or technical problems, all located at distances within 35 kilometres of the seat of the pole. The ceramic tile companies in this pole, with the exception of two, just use dry milled raw materials from the Corumbataí Formation, with hammer and pendulum mills.



Graph 1. Distribution of some deposits in the Santa Gertrudes region, differentiating those that explore the levels at the top and at the base of the Corumbataí Formation (modified from [2] p. 122).

The Corumbataí Formation is a stratigraphic unit from the Permian age of the Paraná Basin, which is arranged in concord on the bottom unit (Iratí Formation), is covered in erosive discordance by the Pirambóia formations (Triassic-Jurassic) and Rio Claro (Tertiary-Quaternary) and, locally, is located next to a diabase intrusion of the Serra Geral Formation (Lower Cretaceous) [1]. In the region of the pole it displays a maximum thickness of some 100 metres and emerges forming a strip in the North-South direction with a width of approximately 10 kilometres. At the base it exhibits a discontinuous layer, with a maximum thickness of about 8 metres, made up of clayey siltite of a greenish grey colouring, and sometimes cream or reddish by oxidation. Along the top there runs a homogeneous seam with an average thickness of some 10 metres, formed by silty argillite of a red to chestnut-purple colour, which passes in a laminated and finely banded package due to interleaving with silitites and clayey silts. The interleaves increase in thickness and representativeness in the direction towards the top, reaching decimetre to metre packages of sandy silitites in intervals of 30 to 40 metres, counted from the base. Toward the top follow decimetre to metre packages of clayey silt and other argillites interleaved with sandy silitites and rare seams of limestone and diatomites, sometimes silicified. Throughout the package there are discontinuous, millimetre to decimetre, levels of *bone bed*, venules and millimetre to centimetre veins of quartz and/or carbonate.

Image 1. General view of a deposit where the base of the Corumbataí Formation is explored. The yellow sandy layer constitutes the upper limit of the base units of the Formation.

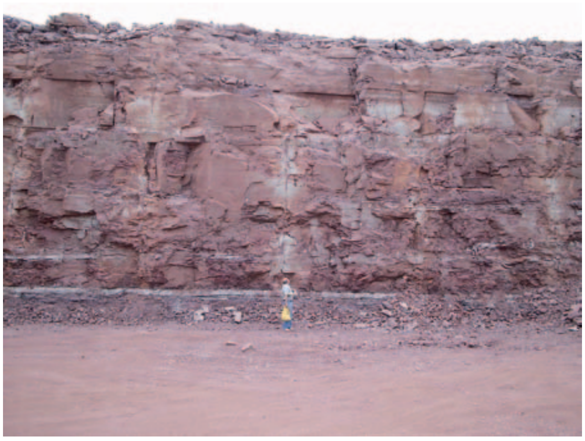


Image 2. General view of a mine in the top of the Corumbataí Formation, made up of chestnut-purple argillite with decimetre interleaves containing a great amount of carbonates.

In a general way, the granular minerals (represented mainly by quartz and detritic feldspars, and by albite and native carbonates) increase towards the top of the sequence, evidencing a clear variation in the vertical direction, a variation that is also observed in the lateral direction, but in a less expressive form.

The Base 1 and 2 samples (table 1) were collected at different points from the same level of a mine located in the base of the Corumbataí Formation, and show a small horizontal variation in their chemical composition. The other three samples in the same table were collected in another mine at three different levels corresponding to the upper part of the formation; in this case, the variations are more significant.

Sample	LOI	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	CaO	MgO	Na_2O	K_2O	P_2O_5
Base 1	3,04	67,47	14,40	5,04	0,65	0,10	1,15	1,90	2,69	3,33	0,24
Base 2	2,27	69,28	13,97	5,45	0,54	0,02	0,45	1,64	3,11	3,22	0,11
Top 1	6,13	61,96	12,60	4,63	0,54	0,08	4,57	3,05	2,86	3,37	0,22
Top 2	9,50	60,05	10,82	3,01	0,39	0,09	8,81	2,66	2,52	2,00	0,17
Top 3	5,39	66,87	11,85	4,12	0,48	0,06	2,58	3,47	2,36	2,68	0,15

Table 1. Percentages of the major chemical elements of some samples.

Most of the workings are positioned in the lower part of the Formation, covering a third of its height, where the material is more illitic and practically without carbonate, unless it is in the form of veins and venules [3]. There are also deposits positioned in the centre part of the column, as well as at the top, where the average carbonate content reaches approximately 10% of the volume.

This difference between the top and the base of the Formation affects the milling system of the companies. Some, which hardly use the material at the top in the composition of the masses, improved their milling system. When the grains of albite, quartz and carbonates diminish (more common in these levels), point defects decrease; however, the factories that use clays from the base of the Corumbataí Formation grind coarser, because the clay minerals with a very fine particle size originate pressing defects, such as lamination.

Image 3. Detail of a layer in the base of the Corumbataí Formation: homogeneous seam formed of silty argillite of a red to chestnut-purple colouring, consisting of illite, albite and quartz.

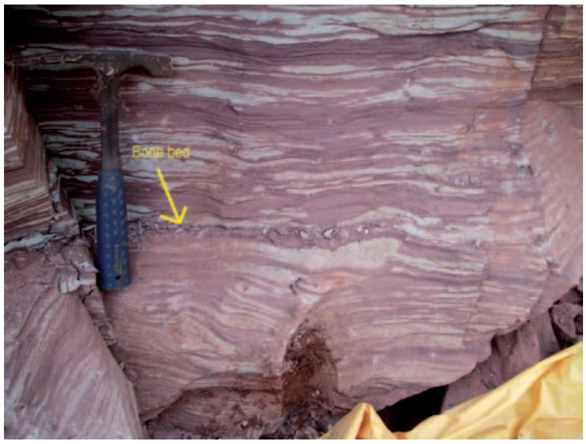


Image 4. Detail of a layer in the top of the Corumbataí Formation: package with interleaves of light-coloured sheets of sandy siltite, consisting of quartz, albite and carbonate and dark layers of argillite, predominantly made up of illite and albite; bone bed is also observed in a centimetre level.

In conclusion, it can be observed that practically all the Corumbataí Formation is used to make ceramic tiles. At the moment, the parts not used are: the more altered part, whose use is restricted to structural ceramics; the basal level, consisting of clayey siltite, owing to its high hardness and greater wealth of quartz and chlorite; some sandier and tougher levels; portions in rich veins and venules of quartz and carbonate, and some levels richer in smectites, generated by supergenic or concentrated processes in drying and the homogenisation.

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