RAW MATERIALS FOR CERAMIC TILES IN THE SANTA GERTRUDES POLE, BRAZIL

José Francisco Marciano Motta [1], Sérgio Ricardo Christofoletti [2], Leonardo Locoselli Garcez [1], Raquel Valério de Souza Florêncio[1], Anselmo O. Boschi [3], Maria Margarita Torres Moreno [2], Antenor Zanardo [2]

[1] IPT - Instituto de Pesquisas Tecnológicas do Estado de São Paulo - Divisão de Geologia – São Paulo, SP, Brazil
[2] UNESP – Universidade Estadual Paulista – IGCE – Rio Claro, SP, Brazil
[3] Universidade Federal de São Carlos/DEMa/LaRC – São Carlos, SP, Brazil

The Santa Gertrudes ceramic manufacturing pole, located in the state of São Paulo, southeastern Brazil, produces around 20 million square meters of tiles per month (~ 240 million sq. m. per year) at 42 manufacturing units (Figures 1 and 2). The main characteristics of the tiles produced here are the body's reddish colour, glazed surface, water absorption between 6 and 10% (BIIb type), and their floor and wall applications, particularly indoor applications. The manufacturing process is characterized by the dry preparation of pressing powders, dry pressed manufacturing, and rapid and single firing. In addition, one particular characteristic of the ceramics produced in the Santa Gertrudes pole is the unique and single raw material (clay) used in the body composition. This material comes from clayey rocks in the Paraná basin, a huge Phanerozoic intracratonic sedimentary basin covering 1,100,000 square kilometers in southern Brazil, and 100,000 square kilometers each in Uruguay, Paraguay and Argentina. In the region of the Santa Gertrudes pole, clayey rocks used as raw material in the manufacture of ceramic tile bodies are grouped in the Permian Corumbataí Formation (Pc). This is a 130-meter-thick layer of shallow reddish marine sediment containing claystone, shale, siltstone and fine sandstone embedded in dark bituminous shale, with carbonate rocks at the bottom (Irati Formation) and topped by fluvial-Aeolian sandstone units (Pirambóia and Botucatu Formation), which forms a coarsening upward sequence characterizing a regressive sedimentary cycle. The main minerals in these clayey rocks are illite, with minor amounts of smectite and kaolinite, and quartz, feldspar, hematite and iron hydroxides. The sandy facies are rich in feldspar, whose granulometric size is less than 120μm. Biogenic fragments (bone beds and coquina) are present in centimetric layers. The main oxides present here and their approximate chemical composition are: SiO_2 (67%), Al_2O_3 (15%), Fe_2O_3 (5%), K_2O (3-4%), Na_2O (0.5%) and CaO (0.5%). Despite a preference for the bottom and intermediary stratigraphic portions of the Corumbataí Formation, mining activities take place throughout the unit, from top to bottom, except where clayey rocks display severe weathering, silica and/or carbonate veins, biogenic concentrations, basaltic intrusions and intercalations of sandy facies. Mining is conducted by traditional open pit methods, involving the usual stages of clearing the vegetation and stripping, followed by blasting or hydraulic scraping (depending on rock strength) using single or multi benches. The ore, in the form of rocks and pebbles, is then loaded onto trucks and transported as run-off-mine to outdoor ageing stockpiles or to a primary crushing plant, where it is spread onto outdoor terraces and subjected to blending, grain size reduction, homogenization and drying. Two or three layers from different extraction points are usually mixed in a final blend. Upon completion of the outdoor operations, the output goes to indoor stockpiles and finally to the dry preparation of pressing powders. The average monthly production of clay exceeds 400,000 tons. Most of the 20 existing mining sites are run by ceramics-owned enterprises, while the remaining manufacturers (about 40%) are supplied by independent producers. From the low technology products of the 1960s, such as bricks, to the current up-to-date technology for fast single firing glazed tiles, the ceramic producers of Santa Gertrudes have followed a highly successfully path. Besides the availability of clay, and its cheap production, this success was possible partly owing to two additional factors: 1) the producers had their own method for preparing the powder for pressing (dry milling); and 2) they had their own method for formulating the powder (single clay body formulation). Initially, these two procedures provided an economical way to produce ceramic tiles sold at commercially competitive prices, enabling them to gain a substantial share of the low income market. The producers then improved the manufacturing process and quality of their products, gaining them a share in other markets, including export markets.

Figure 1. Location and distribution of ceramic plants and clay quarries in the Santa Gertrudes ceramic tile pole.

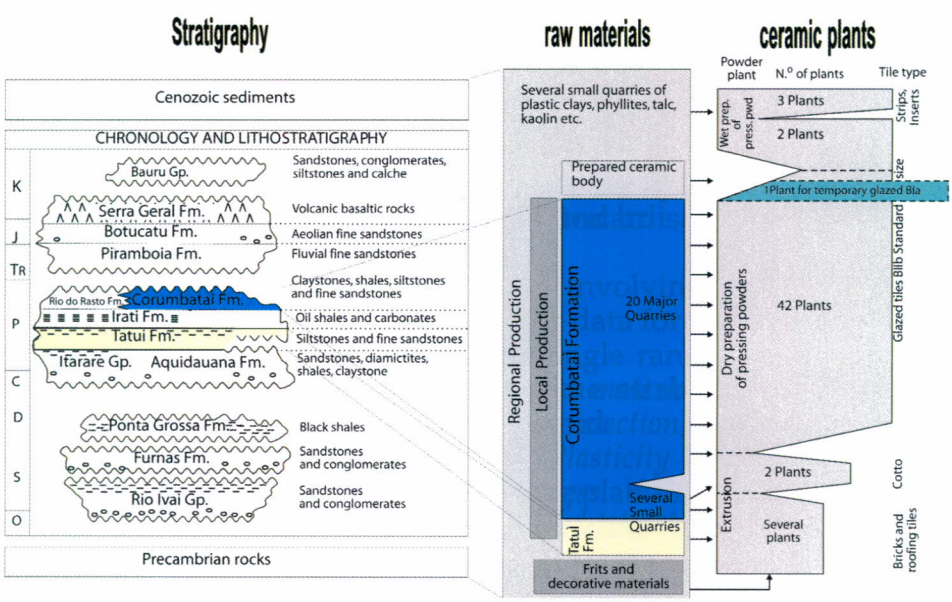

Figure 2. Overview of the geological arrangement, mineral resources, mining activities and ceramic manufacturing in the Santa Gertrudes pole.

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