

Stratigraphy and hydrothermal alteration of amethyst-geode mineralized basalt flows, Serra Geral Group, Entre Rios, Santa Catarina, Brazil

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RESUMO: The stratigraphy of volcanic flows and the understanding of hydrothermal processes are significant geological aspects related to the formation of deposits of amethyst geodes in the Serra Geral Group (Paraná volcanic province - Brazil, Argentina, Paraguay and Uruguay). Ametista do Sul (Rio Grande do Sul) produces 400 tons per month of geodes. In western Santa Catarina, the Entre Rios mines also produce amethyst geodes and are here described. Field geology was integrated with the study of satellite images, scintillometry and chemical analyses of rocks in the ACME Laboratories (Canada) to understand the stratigraphy of the lavas and mineralization processes. The contents of TiO_2 and P_2O_5 (and other elements) are characteristic of each of the seven basalt flows ($\text{SiO}_2 = 44.35$ to 51.63 wt.%) of the region and allow their identification; one additional flow is rhyodacite. Eight flows occur from the Rio Chapecó bed (altitude 380 m a.s.l.) to the top of the hill near Entre Rios (altitude 740 m a.s.l.). The first two are Esmeralda type (low-Ti content and typical trace elements) basalts with low scintillometry (33-49 counts per second, cps). The third flow is a Chapecó type (Guarapuava subtype, high-Ti, $\text{P}_2\text{O}_5 = 0.5$ wt.%) rhyodacite ($\text{SiO}_2 = 63.67$ to 65.42 wt.%) with scintillometry around 135 cps. The four flows above the rhyodacite are Pitanga type basalts (high-Ti and typical trace elements) with moderate scintillometry (60-93 cps). The eighth flow is a Paranapanema basalt type (high-Ti and typical trace elements) with scintillometry around 50 cps, and has silica gossans at the top of the hill, intense silicification, hydrothermal alteration, presence of hydrothermal breccia at the base and polygonal ponds at the surface, resulting from the hydrothermal process. Based on stratigraphic sections on several hills, supported by rock chemistry, several fault-blocks are recognized with downthrow to the west. This structure is comparable to Ametista do Sul. In this investigation, we characterize two basaltic flows that are mineralized with amethyst geodes (fourth and fifth flows). These two flows are Pitanga-type basalts, with aphanitic texture, dark gray color, with small (1-20 mm) amygdaloids filled with silica group minerals (mainly chalcedony) and calcite, and intense hydrothermal alteration as evidenced by the presence of smectite and celadonite. The large (0.2-2.0 m) geodes are partly filled with a sequence of chalcedony (1-40 mm) at the rim followed by colorless quartz and then amethyst. The amethyst has light violet color, and some "dog tooth", white calcite crystals occur in the inner part of the geode. Strongly silicified sandstone and basalt breccia occur at the base of many geodes. Some 1-20 cm geodes are filled exclusively with colorless quartz. These results are significant for mineral exploration in the region, particularly the establishment of the lava stratigraphy, the fault-block structure, the chemical and scintillometric characterization of the two mineralized flows, the Esmeralda-Pitanga-Paranapanema sequence of flows and the description of hydrothermal processes related to the mineralization. The presence of silica gossans is a straightforward suggestion of the presence of additional amethyst geode deposits in Entre Rios.

PALAVRAS CHAVE: SERRA GERAL GROUP, AMETHYST, ENTRE RIOS