Cooling and vesiculation processes of a basaltic lava flow of the Estância Velha Region, RS, southeastern Paraná Basin, Brazil

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The subaerial basaltic lava flow of the Estância Velha region near Porto Alegre (RS) represents the first preserved tholeiitic flood in the southeast side sequence of the Paraná basin in southern of Brazil. This 45 m thick basalt flood unit has three units from bottom to top, based on its distribution vesicle pattern: a lower vesicular zone, an intermediate massive zone, and an upper vesicular zone.

This vesicle zonation resulted from physical processes during the cooling and degassing of the flow. The outgassing process formed a top vesicular zone (15m thick) and a narrow vesicular zone (< 1m thick) at the bottom of the flow. Between these zones there is a central part that is vesicle free.

The flow has wide ranges of mineralogical composition and phase abundance due to different cooling rates. Petrographic textures indicate that the interior of the flow has experienced a slower cooling rate and shows about 15 vol% nonglassy mesostasis, whereas its top and bottom zones have more mesostasis (30-60 vol%) and textural features such as feathery crystals indicative of more rapid cooling. The rate of advance of the cooling fronts for the first few meters of the top and bottom of the flow and in its central part are estimated to be, respectively, 0.23 cm/h, 0.08 cm/h and 0.01 cm/h. Cooling time estimated for the entire solidification of the flow from melt to solidus and from solidus temperature until to ambient temperature were about 35 yr. and 560 yr., respectively, based on thermal models results.