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· XIII SIMPÓSIO SUL-BRASILEIRO DE GEOLOGIA
· IX SIMPÓSIO DE VULCANISMO E AMBIENTES ASSOCIADOS
· I CONFERÊNCIA DE GEOLOGIA E MINERAÇÃO DO MERCOSUL
· II WORKSHOP ARMAZENAMENTO DE CO_2 POR MINERALIZAÇÃO EM BASALTOS
· I EXPOGEOMINE

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"Taken for granite": how crystallization and liquid immiscibility compete during basalt-to-rhyolite differentiation and shape the Daly Gap

Lino, L. M.[1], Vlach, S. R. F.[2], Janasi, V. A.[3], Quiroz-Valle, F. R.[4], Menezes, J.[5]

[1] Instituto de Geociências-USP, São Paulo, Brasil, e-mail: lucas.martins.santos@usp.br; [2] Instituto de Geociências-USP, São Paulo, Brasil, e-mail: srfvlach@usp.br; [3] Instituto de Geociências-USP, São Paulo, Brasil, e-mail: vajanasi@usp.br; [4] Instituto de Geociências-USP, São Paulo, Brasil, e-mail: francy.valle@usp.br; [5] Instituto de Geociências-USP, São Paulo, Brasil, e-mail: joaomenezeslima@usp.br

Although the fractionation of primitive basaltic compositions represents one of the major mechanisms in the origin of more differentiated silicic magmas, compositional gaps occurring along continuous liquid lines of descent are still contentious. In the volcanic record, bimodal volcanic suites are frequently reported for continental rifts and hot spots, whereas they are almost absent in continental arcs where intermediate compositions dominate. Which magmatic mechanisms are responsible for modulating the compositional gaps and magma diversity registered by these different tectonic settings is still debated in the literature. However, the compositional record of melt inclusions shows a similar bimodal spectrum for rifts/hotspots and continental arcs, suggesting an intrinsic magmatic mechanism correlating basaltic magmas from these contrasting tectonic settings. The perception of the role of silicate liquid immiscibility as a feasible magmatic mechanism of differentiation and acting in the origin of the Daly Gap has changed over the past decades. The generally late-stage register of unmixing and the lack of unambiguous evidence for large-scale liquid immiscibility has led petrologists to not consider the unmixing of silicate liquids as a significant mechanism of magma differentiation. We propose that the Daly Gap emerges from a kinetic competition between fractional/equilibrium crystallization and liquid immiscibility, governed by their contrasting enthalpic evolution and activation energies during basaltic solidification. Supercooled basalts can store significant amounts of latent heat, and when compared, equilibrium and fractional crystallization also exhibit contrasting evolutive paths of enthalpy. Thus, supercooling and disequilibrium crystallization can be potentially converted into an excess of heat/enthalpy in the system. In this sense, nucleation barriers can favor crystallization or unmixing, depending on which will have the smaller activation energies and release a greater amount of accumulated heat. From thermodynamics, both mechanisms seem to represent *'two sides of the same coin'* in the production of silicic compositions, the more feasible one being that which releases excess enthalpy and lowers system free energy to a greater extent. As both mechanisms share significant similarities concerning their thermodynamic controls, the silicic products of differentiation and Si-rich immiscible liquids can be indistinguishable. In this sense, which mechanism should be invoked to explain the Daly Gap for cogenetic bimodal suites must be reassessed instead of being taken for granted in the case of equilibrium/fractional crystallization.

Keywords: Daly Gap, Liquid immiscibility, Activation energy, Basaltic differentiation, Bimodal volcanism

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