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# Numerical simulation of the formation of the IDDP-1 rhyolitic melt (Krafla volcano, Iceland)

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We simulate the formation of rhyolitic magma at Krafla volcano, Iceland. This magma was sampled during drilling by the IDDP-1 international program. Developed thermochemical model of heat transfer from a convecting basaltic intrusion to the host felsic rocks represents melting event and production of the hot rhyolite magma. Based on the temperature histories produced by the modelling, zircon dissolution and growth were simulated.

The thermochemical model is based on the heat conduction equation, which accounts for the release of the latent heat of crystallization and convection in a two-layered system with contrasting compositions. The lower layer contains initially injected basaltic magma that releases heat to the surrounding felsic rocks. The model accounts for the phase diagrams for Krafla basalt and the Viti granophyre produced with the Rhyolite-MELTS. Based on the calculated temperature distribution and the thickness of the molten basalt, the Rayleigh number and the effective thermal conductivity are parametrized based on [1]. The effective conductivity is up to 3 orders of magnitude larger than the thermal conductivity of basalt. This leads to the uniform temperature distribution within the sill. The heat released from the basalt leads to melting of felsite to form rhyolitic melt. After a critical melt layer thickness is reached, it begins to convect. The basaltic layer after ~ 10 years of cooling crystallizes significantly and the convection in this layer stops reducing the rate of heat transfer. The melting of the felsite slows down and the upper layer starts to solidify. An example of the temperature and the melt fraction evolution with time is shown in **Fig. 1** for a basaltic layer 150 m thick. Solid lines correspond to the basalt, dashed lines to the rhyolite. Numbers represent the distance from the initial interface between the magma and the wall rocks. Basaltic magma melts ~ 20 m of felsic rocks in a matter of 4 years. After 34 years, the melt fraction in basalt decreases to less than 20 %, while the crystallinity of the felsic layer remains low.

The code in MATLAB is available at https://github.com/crystalworkshop/krafla_sill.

[1] Turner, J. S. (1979). Buoyancy effects in fluids.

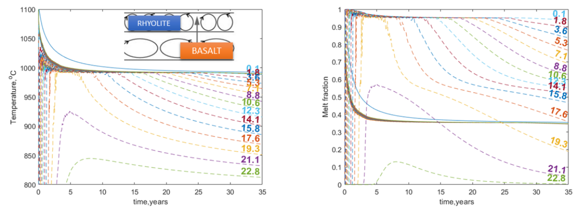


Fig. 1. Evolution of the temperature (left) and melt fraction (right) for the basalt (solid lines) and rhyolite (dashed). Labels represent the distance from the contact between magmas. Solid blue line corresponds to the center of basilic sill.