
Evaluation of the rheological parameters of an Icelandic basaltic flow (Krafla) using a high-resolution morphological approach.

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Résumé

The Icelandic rift, an active opening zone in the N10 direction, features intense fissural volcanic activity, particularly in the Mývatn region (north-east of the island) with the Krafla volcanic system. The last major eruptive episode was the "Krafla fires" (1975-1984). In that context, the assessment of rheological parameters (internal and external) remains essential in the characterization of active systems' flows, as they have a direct impact on the shape of the post-eruption flow (spread, thickness, etc.). Certain morphologies recorded post-eruption on the flow surface, such as lava tubes or channels, are clues for characterizing the evolution of the flow's intrinsic parameters in reaction to its environment (extrinsic parameters) during its emplacement.

Certain parameters governing flux behavior (viscosity, yield strength, temperature, etc.) are generally determined chemically. The aim of this study is to accurately assess the variations in these parameters during the early stages of a volcanic episode. A morphological analysis approach based on field observations and very high-resolution drone acquisition is thus employed. The goal is to gain a better understanding of the dynamics of basaltic flows and to gain an initial insight into the internal and external properties of the system. To illustrate this, a secondary tholeiitic basaltic flow (annexed to the main flow) from the terminal phase of the "Krafla fires" was chosen. This flow is bayonet-shaped and partially channeled by the edges of the actual rift. The study focuses on the first moments of the eruption, so only the upstream part of the flow is analyzed (300 m).

The pahoehoe flow shows a progressive fragmentation from upstream to downstream, resulting in a transition from sheet pahoehoe to spiny pahoehoe and rubbly pahoehoe. The results obtained morphologically for this flow are within the ranges known for other cases of Icelandic basaltic flows (2 to 4 Log Poise for viscosity), showing that the morphological approach is consistent with the chemical approach. The morphological approach employed follows the approach developed by Chevrel et al. (2013), evaluating viscosity and yield strength according to three criteria: flow width, flow thickness and channelling within the flow.

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