# Abstract

Variability of magmatic textures records a wide array of physicochemical and mechanical processes that have operated in a magma chamber during its crystallization. Here I investigate how the final textural record can quantitatively be used to decipher the magma crystallization history and internal dynamics of magma chambers. The thesis is based on a formulation of numerical models of texture formation under the activity of various crystallization processes. Numerical results are then compared to the new quantitative textural datasets derived from four distinct magmatic systems in the Bohemian Massif: (*i*) Fichtelgebirge-Smrčiny granite batholith; (*ii*) Krkonoše-Jizera plutonic complex; (*iii*) Kdyně mafic intrusion; (*iv*) České středohoří volcanic complex. Combination of the field textural studies with their interpretation *via* numerical crystallization models provides new implications regarding magmatic crystallization and internal dynamics of magma chamber. The most important results of this Ph.D. thesis are as follows:

(*i*) a new method has been developed that allows the rates of nucleation and growth of crystals to be derived from quantitative textural data. The method requires using the crystallinity evolution in time as an independent constraint in order to provide unique solution. In case of the Hawaiian lava lakes, where direct observation of magmatic crystallization was possible, the calculated rates are in the order of $10^{-11}$ cm $s^{-1}$ and agree well measured values;

(*ii*) forward numerical modeling of texture formation provided a quantitative connection between the rates of nucleation and growth and final textural record. Simulated textures suggest that the effects of crystallization processes other than is homogeneous nucleation and growth of crystals on final textural record can be separated using conventional and non-traditional textural descriptors. Quantitative relationships are calibrated between the

textural parameters and the extent of heterogeneous nucleation and mechanical interstitial melt extraction efficacy;

(*iii*) application of numerical results to natural magmatic textures ranging from granites and mafic cumulates to porphyritic volcanic rocks suggests that heterogeneous nucleation is generally a dominating mechanism of formation of nuclei in silicate magmas. Extraction of interstitial melt thus the crystal/liquid separation and accumulation of crystals is ubiquitous process in porphyritic rocks where large crystals are supposedly present in magmatic suspension;

(*iv*) in porphyritic granites the textural record indicates that large intrusive unites of plutonic complexes can be emplaced rapidly as single magmatic batches that undergo subsequent internal differentiation by mechanical processes as crystallization proceeds;

(*v*) in the Jizera granite (Krkonoše-Jizera plutonic complex) the melt extraction was most effective close to the floor and roof of more than 550 m thick intrusive unit while the crystal-melt separation was negligible in the unit interior. These observations support a new differentiation model in which the crystals suspended in a convecting magma are captured from the suspension as the melt percolated through the rigid crystal frameworks of the upper and lower solidification fronts.

In general, these results illustrate that integration of numerical modeling and field textural studies provides a powerful tool for interpreting the solidification dynamics and internal lifestyle of magma chambers.