Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16597

Consequences of melt-mush reactions on mush-dominated magma reservoirs: the melt flush process exemplified at mid-ocean ridges

MARINE BOULANGER[1] AND DR. LYDÉRIC FRANCE[2]

[1]Université Clermont Auvergne
[2]Université de Lorraine, CNRS, CRPG
Presenting Author: mgeoblg@gmail.com

The identification of mush (crystal-rich igneous medium) as the dominant medium in oceanic magma reservoirs questions its potential impact on the processes leading to the differentiation of melt and associated plutonics formation at depth. Especially, the classical process of fractional crystallization is hampered at high crystal fractions. Widespread evidence for the occurrence of crystal-melt interactions is found in numerous magmatic oceanic crust sections, on which rely the current characterization of melt-mush reactions (MMR). These reactions seem to strongly shape the structure, mode, textures, and chemistry of the cumulates they impact. However, the thermodynamic feasibility of MMRs and the extent of their potential impact is often questioned.

We investigated different key MMRs with the Magma Chamber Simulator[1] (MELTS models based) to test their thermodynamic feasibility and in an attempt to better quantify their characteristics. First-order results show that one-step equilibration of primitive melts with primitive to moderately differentiated mush crystals triggers mineral assimilation (of up to 21% of the initial solid mass). Concomitant crystallization is observed, yet the assimilation on crystallization ratios for the thermodynamically-constrained reactions suggests that most of the crystallization recorded in natural samples results from post-reaction progressive cooling of the magmatic system. In addition, it seems that the porosity of the system can be maintained during the melt-dominated stage of reactive porous flow while a new generation of minerals forms at the expanse of the initial mush-forming minerals.

We eventually propose a new igneous process that considers 1/ the presence of mush in 2/ open magmatic systems subject to repeated primitive melt recharges where 3/ MMRs strongly impact the forming gabbroic cumulates. The **melt flush process**[2] relies on the progressive extraction by buoyancy and replacement of interstitial mush melts by the primitive recharge melts triggering interactions. The melt flush process is subsequently a key cumulate forming process that adds to other processes involved in cumulate formation like magma compaction or crystal settling, and is potentially applicable to any magmatic systems sharing similar reservoir characteristics.

1. Bohrson, W.A., et al. (2014). Journal of Petrology 55.
2. Boulanger, M., France, L. (2023). Journal of Petrology, Perspectives in Petrology, egad005.