Numerical modelling of magma plumbing system interactions at Torfajökull, Iceland: an insight from the crystal cargo

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Torfajökull is the largest silicic centre in Iceland. Situated in the south east, it intersects the southern tip of the Veiðivötn fissure swarm[1]. Previous whole rock studies have identified mixing between rhyolitic and basaltic products[2]. This could represent interaction between hot basaltic melt and solid rhyolite or intrusion of basaltic melt into a rhyolitic magma chamber. If it is the latter it could have major implications for eruption trigger mechanisms at Torfajökull.

We have undertaken textural, CSD and chemical analysis on crystals hosted in lavas ranging from basalt to rhyolite. All samples show a range of microtextures observed in both plagioclase and clinopyroxene crystals which, alongside CSD analyses that indicate at least two different plagioclase populations, suggests evolution through open system processes. LA-ICP-MS of clinopyroxene and plagioclase crystals from a single lava show clinopyroxene compositions to vary within a narrow range (Mg#~72-82) whilst plagioclase shows significant variation in core An% (38-80), indicating multiple populations, and exhibits both reverse and normal zoning. P-T conditions calculated using the equations of Putirka[3] and an estimated equilibrium melt composition show that different populations crystallised at different conditions. $\delta^{18}O$ crustal data will be used as additional evidence for distinguishing between melt mixing and crystal contamination.

This insitu data is being used to test a simple numerical forward model that combines published equations for calculating crystal growth rates and compositions with methods for assessing the effects of various petrogenetic processes on the host melt[3,4,5]. The model outputs a thin section style image that allows comparison with insitu chemical data and textural analysis.

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