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Crystallization kinetics in anhydrous and hydrous trachytic to latitic melts subjected to variable degrees of undercooling

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Decompression and cooling occur during magma ascent within volcanic conduits during eruptions. Water saturated magmas, when subjected to decompression-induced H_2O loss from the melt can be expected to crystallize, due to the effects of H_2O loss on magma liquidus temperatures. Decompression-induced crystallization may thus produce large changes in viscosity during magma ascent towards the surface and potentially influence eruptive styles (e.g., effusive vs. explosive). Hydrous basaltic magmas are able to crystallize rapidly even during fast ascent and decompression rates within conduits, promoting highly explosive eruptions [1]. Trachytic and latitic magmas of Campi Flegrei (Naples, Italy) produced highly explosive eruptions in the phlegrean volcanic area, but the effect of crystallization on magma viscosity during ascent and on the eruptive style is poorly investigated. Here we investigate effect of continuous cooling and decompression on crystallization kinetics of trachytic and latitic melts through cooling and decompression experiments conducted in an internally heated pressure vessel (compositions more mafic than the trachy-phonolite studied by [2]). We conducted H_2O-saturated isobaric cooling experiments (continuous cooling at 0.125, 0.5, 3, and 12.5 °C/min) at P of 200 and 50 MPa, and isothermal decompression experiments (1.15, 6.92, and 23.03 MPa/min) at 975 °C and 200 to 50 or 25 MPa. Preliminary observations suggest that the presence of H_2O in these experiments aids the nucleation and growth of feldspar crystals compared with the dry case [3]. The results indicate that the effects of H_2O on crystallization kinetics in the more mafic trachytic and latitic melts discussed here could be slightly less than the effects observed for trachy-phonolitic melts [2]. However, this depends on the effect of water on the crystallization temperature of the individual phases and on crystallization kinetics which are controlled by melt water content and diffusivity.

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[2]Arzilli, F, et al. (2016), Bull Volc, 78: 72. DOI: 10.1007/s00445-016-1062-z

[3]Iezzi, G, et al. (2008) Chemical Geology, 253, 91-101.