Segregation of felsic melts from a mafic crystal mush in a shallow-level magma reservoir: Implications for continental crust formation

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Continental crust has an average composition of 60.6 wt. % SiO_2 [1] and hence is not in equilibrium with partial mantle melts. Fractional crystallization of mafic melts and the subsequent extraction of interstitial melt have been proposed as a mechanism to generate more evolved rocks in arc settings [2]. However, the rates, physical mechanisms and range of melt compositions produced by this magmatic process remain controversial, mostly due to a lack of direct observation in the rock record of exposed igneous bodies. Field studies and isotopic data indicate that decimetre-sized, lensoid-shaped, high-silica felsic segregations (≥ 70 wt. % SiO_2) present in the gabbros (~ 49 wt. % SiO_2) of the Guadalupe igneous complex (Sierran Foothills, California) have formed from their hosts by crystal-melt separation and melt segregation.

Granophyric textures, large grain sizes and hydrous minerals in the segregations indicate rapid cooling under fluid-rich conditions. Further, the spatial proximity of the segregations to gabbro layers lacking hydrous minerals indicate that those could have fed the segregations by filter-pressing of fluid-rich, low-viscosity residual liquids. Single mineral chemistry of minerals in the segregations and the host gabbro and modelling with the thermodynamic program MELTS better constrain the chemical evolution of the parental magmas, rates and timing of melt segregation and the amount of crystallization in the crystal mush during melt extraction.

Although the felsic segregations are not volumetrically significant in terms of continental crust production, it is however shown that they provide a potential high-silica endmember to mix with less evolved melts to form typical upper crustal granitoid bodies.

[1] Rudnick & Gao (2014), *Treatise on Geochemistry* **3**, 1-64.
[2] Bachmann & Bergantz (2004), *Journal of Petrology* **45**, 1565-1582.