Thermal and Uranium-series isotope constraints on the rate and depth of silicic magma genesis

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Uranium-series isotopes provide important limits on the timescale of magma differentiation and this can be used to constrain where in the crust and silicic magmas acquire their geochemical characteristics. Timescales of differentiation can be inferred from the observed co-variations of U-series disequilibria with differentiation indexes. When crustal assimilation of secular equilibrium material is involved, inferred timescales will generally decrease. In turn, they will increase if periodical recharge (> 20 wt. % relative volume) of the magma body occurs. If crustal assimilation and magma recharge occur concurrently, inferred timescales for differentiation can be similar to that of closed system differentiation. We illustrate the approach with data from Mt St Helens which suggest that dacitic compositions are produced in ~ 2,000 yr. Combining this with recent evidence for an important role for amphibole fractionation suggests that differentiation of a ~ 10km^3 magma body at this volcanic centre occurs at 8-10 km depth in the crust.