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Consequences of U-series disequilibria for thermal maturation models for silicic magma production and the time scales involved

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A number of recent models argue that silicic arc magmas are the products of thermal maturation and remelting due to repeated basalt intrusion into the lower crust, rather than fractional crystallisation. Published numerical simulations indicate that the time required for thermal maturation to the point of voluminous dacite/rhyolite production is on the order of a million years. Simple calculations show that very little disequilibria is likely to result from 10-20% partial melting of amphibolite. Thus, the endmember version of the thermal maturation model is, at face value, inconsistent with the common observation of disequilibria between short-lived U-series nuclides in silicic arc lavas. Nevertheless, the extent of disequilibria in silicic arc lavas is usually less than that observed in the associated more mafic lavas. Possible explanations are (1) that the silicic magmas are the products of direct fractionation from a juvenile basaltic parent within a few 1000 years or (2) that the disequilibria observed in silicic arc lavas reflects a mixing of some juvenile basalt into silicic crustal melts which themselves are in secular equilibrium. We show here that the proportion of juvenile basalt required by the range of observed disequilibria varies from 10% up to as high as 80%. Proportions around 10% seem plausible but require independent geochemical evidence for mixing and/or partial melting to verify. In this context, the common observation of decreasing disequilibrium with increasing silica provides a *maximum* time scale for differentiation. Reassessment of the time scales involved using AFC and/or two end-member mixing models will be presented for comparison with published estimates. Significantly, higher proportions of basalt would be unlikely to mix, no longer yield silicic mixtures and Occam's razor argues for a predominace of direct fractionation from basalt in silicic arc magmas preserving significant disequilibria.