Petrogenesis of adakitic rocks at arcs: insights from variations of eruptive style with convergence rates and surface heat flux

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Using global correlations of effusive eruption style with convergence rates and surface heat flux at volcanic arcs, several arcs are identified with excess surface heat flux, related to the presence of unusually hot and H2O-poor magmas. Geophysical evidence suggests that these melts are linked to discontinuities in the subducting slab, which would facilitate upwelling of hot sub-slab asthenospheric mantle. It is demonstrated that excess heat flux arcs are sites of generation for Sr-rich adakitic compositions, and that the arc proportion erupting Sr-rich adakitic magmas is directly proportional to the degree of observed heat flux excess. A model is presented, where the formation of Sr-rich adakitic compositions, which require garnet as a residual phase, is facilitated at excess heat flux arcs due to a decrease in H2O content through contributions from sub-slab asthenospheric mantle, leading to an expansion of the garnet stability field. Future geochemical, geophysical and experimental work to test this model is suggested.