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Batholith formation

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Batholith formation is the result of a complex interplay between thermal and mass transfer processes operating on vertical lengthscales constrained broadly by the average thickness of continental lithosphere and horizontal lengthscales much greater, for example in Cordilleran arcs a factor of 10 or more. Timescales on the other hand, when defined by total average construction times, extend over millions of years although the largest part may reflect the summation of intervals between successive intrusive events that are themselves short lived. Four generic stages comprise batholith formation on earth: melt generation, melt segregation, magma ascent and magma emplacement. This system of heat transfer from deeper to shallower levels and the overall chemical composition of batholiths is governed physically by a complex interplay between the equations of momentum and heat transfer. The intrinsic and extrinsic thermodynamics of the problem are understood variably depending upon which stage of the process one chooses to investigate. However, despite the obvious fact that batholithic terrains of different ages exist, implying a repeatable process at work, a system-wide understanding (a grand unified theory if you like) of batholith formation remains elusive. One aspect of the momentum problem, magma rheology, is the subject of new experimental and theoretical work that from a mechanical perspective provides a link between each stage of batholith formation from source to emplacement. This talk will focus mostly on our understanding of magma rheology in an attempt to quantify more precisely batholith formation as a problem of both ‘mass in motion’ and ‘mass at rest’.