Why do intermediate magmas stall?

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The continental crust is formed dominantly from basaltic melts in island arcs. During melt transport and final emplacement at shallower levels, melts undergo differentiation processes, which drives their chemical composition towards more intermediate composition. These processes lead to a chemical stratification with a mafic lower and a intermediate upper continental crust. Yet, the overlying volcanic rocks are dominantly mafic in many arc systems. The global character of this chemical stratification implies that the processes responsible for the selective accumulation of felsic magmas in the upper crust are fundamental for the construction of continental crust. A mechanism must exist that preferentially traps more felsic melts in the upper plutonic crust, whereas more mafic melts are able to continue to rise to the surface to form volcanic rocks.

We investigated possible melt stagnation mechanisms by studying phase petrological control on melt stagnation using a suite of felsic plutons constituting the upper crustal portion of the Kohistan arc. We show that the pressure and temperature of emplacement recorded in the Kohistan granitoids coincides with an interval when the melts encounter a copious crystallisation interval (CCI). The CCI for felsic melts are related to either volatile saturation at lower pressure (≤ 6kbar) or quartz saturation at higher pressure (> 6 kbar). We show that because of these phase petrological constraints on melts stagnation, the transport distance of the melts is in strongly controlled by their ascent path.