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On the importance of crystallization-differentiation for the generation of SiO_2-rich melts and the compositional build-up of arc (and continental) crust

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In this presentation we review processes responsible for the formation of granites in subduction systems. While there is robust evidence that strongly peraluminous, so-called S-type granites are formed by melting of metasediments in the (lower) crust, the processes that form metaluminous, so-called I-Type granites are less certain. We review four lines of evidence that have been presented in support of a dominantly crustal origin for these granites: 1) field observations; 2) isotopic compositions; 3) the missing cumulate problem and 4) the bimodal distribution of igneous rock compositions. We show that in most cases the evidence is at least equally permissive of a process dominated by crystallization-differentiation. Moreover, we show that this mechanism is more efficient than re-melting and avoids additional difficulties associated with the source of heat and or fluids necessary for productive partial melting. Lastly, we show with a simple stochastic model that crystallization-differentiation also explains the first-order compositional and density stratification of arc crust and hence continental crust. We conclude that the structure of arc crust is comparable to oceanic crust at fast spreading ridges and may be controlled by analogous melt transport and stagnation mechanisms.