From anatectic melt to granite magma: enhancing maficity by assimilating mafic rocks at the source

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Granites are produced as a consequence of partial melting middle and lower continental crust. However, leucosomes and experimental melts are compositionally more felsic than most granites in the crust. Thus, processes other than just melting are necessary to account for greater maficity of many granite magmas. Current models emphasise entrainment of residuum and peritectic phases in the melt to increase maficity. No consideration has been given yet to the contribution that less fertile lithologies in the source might make in providing the components necessary to make a mesocratic or melanocratic granite magma.

The Kinawa migmatite in the southern São Francisco Craton of Brazil is the product of water-fluxed melting (<730°C and 0.5-0.6 GPa) of a leucogranodiorite which contained dykes of amphibolite. The migmatite is mostly pink diatexites with leucosomes, but also contains minor amphibolite and metatexites.

Amphibolites occur as massive or banded Hbl+Pl, and rarely Hbl+Pl+Cpx, schollen in the diatexite migmatite and melted little. Amphibolite schollen show a progression of complex morphologies indicating mechanical and chemical interaction with the surrounding diatexite magma. Diatexite and leucosomes immediately adjacent to the schollen have higher contents of hornblende and/or biotite than diatexite farther away. Geochemical modelling shows that the wholesale entrainment, i.e assimilation, of disaggregated amphibolite, or the preferential entrainment of hornblende or plagioclase into the diatexite adds FeO+MgO, CaO and TiO_2, resulting in a dilution of SiO_2. These changes in whole-rock composition increase the maficity of initially leucocratic diatexite magma and drive its bulk composition to mesocratic and even melanocratic granite, comparable to the more mafic compositions of typical I-type granites found around the world. Thus, less fertile mafic lithologies in the source region represent a viable source with which to contaminate anatectic magmas and increase their maficity.