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New experimental constraints on the origin of rapakivi texture in granitoids

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Rapakivi granites are characterized by the typical rapakivi texture consisting of ovoid alkali feldspar megacrysts rimed by a mantle of plagioclase. They may form large batholiths in Proterozoic terranes and have a characteristically metaluminous, A-type chemical composition. In spite of the broad implications of this peculiar granite magmatism in understanding crustal evolution during Proterozoic times, the origin of the rapakivi texture is still largely debated. Here we use a combination of laboratory experiments and equilibrium thermodynamic calculations with MELTS code to test varied hypotheses proposed for the origin of the rapakivi texture. The close association of mafic microgranular enclaves and rapakivi textures is the basis to test open-system processes at variable pressures and temperatures. Although mafic enclaves represent coeval mafic magmas, mixing between the two mingled magmas, mafic and felsic, is not an efficient mechanism to account for the observed disequilibrium textures of rapakivi granites. Isothermal decompression is also not sufficient to produce significant changes in feldspar compositions and change the crystallization sequence. We show here that a combination of reactive assimilation by selective mineral dissolution and isothermal decompression is an efficient mechanism to produce feldspar dissolution and re-precipitation of calcic fledspar. Gain in a Ca-rich component in the decompressing magma is assisted by Ca-rich pyroxene (and Hbl) dissolution. It is a fact that geochemical trends in cotectic-like diagrams departs considerably from fractionation or melting patterns, pointing to important chemical interactions between the two magmatic systems represented by enclaves and granite host. Experiments show that decompression from 1.0 to 0.4 GPa is very efficient in allowing enclave dissolution. At lower emplacement pressures the efficiency of the process increased.