PT.002

Controls on the geochemistry of leucogranites produced by water-fluxed melting of a granitic protolith

Carvalho BB[1], Sawyer EW[1], Janasi VA[2] - [1]Université du Québec à Chicoutimi - Département des Sciences Appliquées, [2]Universidade de São Paulo - Instituto de Geociências

Granites and quartzo-feldspathic gneisses have the potential to produce large volumes of granitic magma in the continental crust during water-fluxed melting. If partial melting occurs via a reaction such as plagioclase + quartz + K-feldspar + H_2O = melt, then the melt produced may have a distinctive composition because neither biotite nor amphibole is a reactant. The melt generated is expected to be leucocratic; moreover it remains leucocratic even if contaminated by its source, because quartz and plagioclase are the most abundant phases in the residua from granitic protoliths. Thus, magmas from granitic sources should differ from those from pelitic rocks in which ferromagnesian phases are more abundant.

We investigate the petrogenesis of the Kinawa Migmatite, part of a reworked Archaean Tonalite-Trondhjemite-Granodiorite (TTG) terrane in the São Francisco Craton, Brazil. This migmatite formed when a leucocratic meta-granodiorite partially melted and generated a considerable volume of leucogranitic magma.

The migmatite consists principally of three types of diatexite: grey, schlieren and homogeneous. Grey diatexites [SiO_2 70 to 73 wt.%; FeO*+MgO+MnO+TiO_2 (FMMT) 3 to 5 wt.%] have a low modal abundance of K-feldspar, but high modal plagioclase, quartz and biotite relative to the protolith; therefore these diatexites are interpreted to be the residuum after water-fluxed partial melting by the reaction plagioclase + quartz + K-feldspar + H_2O = melt, during which biotite remained stable. Geochemical mass balance indicates the degree of partial melting was between 0.35-0.4. Schlieren diatexites [SiO_2 72 to 75 wt.%; (FMMT) 1.15 to 4.3 wt.%] are heterogeneous and composed of biotite-rich schlieren, which represent residuum, alternating with pink coarse-grained quartzo-feldspathic domains, interpreted to have crystallised from melt. The homogeneous diatexites [SiO_2 73 to 75.65 wt.%; (FMMT) 0.49 to 3 wt.%] are leucocratic, have no schlieren and are characterised by an igneous microstructure in which euhedral to subhedral plagioclase (An_{25}) forms a framework. Microcline in these rocks contains rounded inclusions of plagioclase and quartz; the former typically have compositions (An_{30}) similar to plagioclase in the residual grey diatexites, and thus are interpreted to be residual crystals carried in the melt.

Crystal fractionation can explain the broad geochemical trends of the homogenous diatexites and the leucosomes, but it cannot explain all the features. Geochemical modelling shows that incomplete segregation of melt from its residuum is also evident in the schlieren diatexites, which contain the largest (up to 50 %) residual component. A similar, but smaller contamination effect can also be traced in the homogeneous diatexites. Although these diatexites correspond to a magma containing a high fraction of anatectic melt, entrainment of up to 15% residual plagioclase and 9% quartz results in geochemical compositions that are different from those expected for a pure melt (e.g., higher CaO + Na_2O contents). Thus, the compositional trends in leucogranites generated by water-fluxed melting of a granitic protolith are controlled by both incomplete segregation and crystal fractionation.