Petrogenesis of Granites from the Ediacaran Socorro Batholith, SE Brazil: Constraints from Geochemistry and Sr-Nd-Hf Isotopes

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Whole rock elemental and Sr-Nd isotope geochemistry and *in situ* zircon Hf isotope geochemistry was used to identify the sources of the Neoproterozoic granites from the Socorro Batholith, Socorro-Guaxupé Nappe (SGN), South Brasilia Orogen, Brazil. Ti-in-zircon thermometer, zircon and apatite contents and trace element concentrations provided information about crystallization conditions. Three main types of granites built the bulk of the batholith, beginning with probably pre-collisional ~640–630 Ma charnockites, and ending with ~610 Ma voluminous post-collisional high-K calc-alkaline (HKCA) I-type granites (Bragança Paulista-type). The interval from collisional to post-collisional period was marked by the generation of several types of leucogranite (SiO_2>72 wt.%) that occur in the southern portion of the batholith and have a range of geochemical and isotope signatures, reflecting melting of different crustal sources in between ~625 Ma (Bocaina Pluton) and ~610 Ma (Bairro da Pedreira Pluton). The leucogranites have strongly negative εNd(t) (-16.2) and average zircon εHf(t)= -16 and high $^{87}Sr/^{86}Sr_t$ (0.7156-0.7171), consistent with relatively old ortho and paragneiss sources similar to those which generated regionally abundant migmatites and anatectic granites in the collisional to post-collisional setting. Two main charnockite bodies occur in the study area: the ~640 Ma Socorro charnockite has remarkable chemical similarities with Bragança Paulista-type granites, but less negative εNd(t)= -6.1 and average zircon εHf(t)= -9.1 and lower $^{87}Sr/^{86}Sr_t$ (0.7093), indicative of a more juvenile water-poor source. The ~633 Ma Atibaia charnockite has distinct geochemical signature (lower Mg# and Sr content; higher Zr), more negative εNd(t)= -14.1, similar average zircon εHf(t)= -8.9, and much higher $^{87}Sr/^{86}Sr_t$=0.7197, probably reflecting a larger component from old crust. The predominant ~610 Ma Bragança Paulista-type granites were emplaced in a post-collisional setting, and correspond to porphyritic biotite-hornblende monzogranites of high-K calc-alkaline character with 61-67 wt.% SiO_2, high Mg# (39-42), high LILE (K, Ba, Sr) and low HFSE (Zr, Hf, Nb). They show very negative εNd(t) (-12.3 to -12.9) and zircon εHf(t) (-12 to -17) and $^{87}Sr/^{86}Sr_t$=0.7119–0.7131. The Zr saturation and Ti-in-zircon temperatures of the HKCA Bragança Paulista granites are low (TZr=730-780 °C) while TAp yields are much higher (950–1.000°C). Strongly fractionated REE patterns with weak negative Eu anomalies and high Sr/Y (19-40) ratios are consistent with melt equilibration in a thickened crust with residual garnet. A contribution from (enriched) mantle is suggested by high mafic mineral content, presence of mafic microgranular enclaves and apparently high liquidus (apatite saturation) temperatures. These melts from enriched mantle sources emplaced in the lowermost crust, heated host old continental crust rocks (gneisses and granulites) and partially mixed with their melting products.

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