FROM HIGH (> 0.8 GPA) TO LOW (CA. 0.5 GPA) PRESSURE CRYSTALLIZATION: EVIDENCE FROM THE GROSSULAR-RICH MAGMATIC GARNETS OF THE GALILÉIA BATHOLITH, BRAZIL

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In S-type magma generation, the incongruent melting of mica-bearing metasediments produces peraluminous melts, which are in equilibrium with Al-rich minerals such as garnet. Consequently, when S-type granites are sufficiently femic, either cordierite or garnet crystallize in addition to biotite. In contrast, incongruent melting of intermediate rocks to form I-type granites, produces peritectic clinopyroxene and a less peraluminous melt. Such magmas crystalize hornblende and/or pyroxene in addition to biotite. In such rocks, garnet crystallization is very rare and of special petrogenetic significance. The Neoproterozoic (630 – 575 Ma) Galiléia batholith (ca. 30000 km^2), located in the Araçuaí Orogen, is a weakly to moderately foliated calk-alkaline Cordilleran-type granitic body, hosting mafic enclaves up to 4 - 5 m^2, and displaying SiO_2 and CaO contents between 62 to 72 wt% and 2.8 to 6.1 wt%, respectively. Despite its weakly peraluminous to metaluminous (ASI 0.97 – 1.07) character and the presence of hornblende, the batholith is characterized by the widespread occurrence of garnet (grossular 25 – 43 mol%) and epidote. Garnet forms euhedral and anhedral crystals up to 6 mm across. Three main lines of evidence suggest a magmatic origin for these crystals: i) presence of garnet inclusions in sub-idiomorphic alkali-feldspar crystals in undeformed granites, ii) the occurrence of mineral inclusions in garnet which match the matrix minerals in the sample; iii) the widespread garnet distribution irrespective of the degree of matrix deformation. Furthermore, garnet does not appear to be inherited from the source or wall rock, because the Galiléia rocks and garnet-free Cordilleran-type granites have similar ∑HREE content, both ranging from ca. 1 to 10 ppm. Epidote inclusions in garnet have the same Pistacite content (9 – 23 mol %) as matrix epidote. Likewise, low Si-phegite-like white mica inclusions (Si ≈ 3.2 a.f.u.) show similar petrographic and chemical features with white mica in the matrix. Overall, this suggest that these minerals are also magmatic. Crystallization experiments on calc-alkaline metaluminous systems show that grossular-rich garnets are indicative of high pressures (> 0.8 GPa). The coexistence with other high pressure minerals such as epidote, white mica, as well as the rare occurrence of zoisite (FeO_{tot} < 2 wt %), as inclusions in garnet suggest that the Galiléia granitoids started crystallizing in the lower crust at ca. 30 km depth. Plagioclase + quartz coronas around garnet indicate that garnet was in disequilibrium during the evolution of the magmatic system, suggesting a two stage emplacement history for the batholith: the first one took place at 0.8 – 1.0 GPa, followed by a second crystallization stage at pressure of ca. 0.5 GPa, and temperature < 700 °C. These last P-T conditions are recorded by the host metasediments. The Galiléia grossular-rich garnets have higher CaO content than the experimental garnet referred above and have compositions similar to some metamorphic and/or peritectic garnets from ultra-high pressure (> 1.5 GPa) rocks. This suggests that during the Galiléia granitoid genesis, the Araçuaí orogen was already over-thickened favouring a continental-continental collision setting, instead of oceanic subduction.

KEY WORDS: GROSSULAR-RICH MAGMATIC GARNETS; GALILÉIA METALUMINOUS GRANITOIDS; ARAÇUAÍ OROGEN