Carbonate-bearing source of fluids in leucocratic granitoids associated with granulites of the Southern Marginal Zone, Limpopo Complex, South Africa: a case of study of carbonate-silicate inclusions in garnet

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We present a study of the carbonate-bearing polyphase inclusions in garnets from leucocratic granitoids intruding the Southern Marginal Zone (SMZ) of the Neoarchean Limpopo high-grade complex, South Africa, in the post-peak stage 2710-2650 Ma (U-Pb ages of zircons). Abundant CO_2 fluid inclusions in quartz and T-X_{CO2} phase equilibria modeling via PERPLE_X imply an essentially carbonic fluid in the granitoids. Cores of garnet grains contain polyphase carbonate-bearing inclusions with a distinct negative crystal shapes. The major carbonate is strongly zoned magnesite-siderite variety, whereas a predominant silicate phase is pyrophyllite. Raman spectra of unexposed inclusions revealed a presence of dense CO_2, as well as CH_4 and H_2O. The carbonate-bearing inclusions coexist with polyphase «granitic» inclusions. Modeling of the mineral assemblage inside the carbonate-bearing inclusions shows that their present mineral and chemical composition is a product of interaction of the trapped aqueous-carbonic fluid (with dissolved Mg-carbonate component) with the host garnet during cooling below 400°C. This fact is taken as an evidence for origin of the fluids by devolatilization of the Mg-rich carbonate-bearing greenstone lithologies of the Kaapvaal craton buried under the SMZ. Being generated at temperatures between 550 and 700°C, the fluid subsequently participated in anataxis and coexisted with the granite magma during the uplift of the SMZ granulites and their interaction with the craton.

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