



From source to surface: clues from garnet-bearing Carboniferous silicic volcanic rocks, Iberian Pyrite Belt, Portugal

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Abstract

This work investigates the relationships between partial melting, melt extraction, pluton growth and silicic volcanism in garnet-bearing felsic volcanic rocks that were extruded in the Iberian Pyrite Belt, at ca. 345 Ma. The garnets are of peritectic origin, displaying textural and chemical features of disequilibrium crystallization during partial melting reactions involving biotite at high temperatures (up to 870 °C) in the middle-lower crust. Major element composition suggests compositional equilibrium with the entrained and pinitized peritectic cordierite, but reveals some subsequent homogenization by diffusion. Trace element maps and spot analyses of garnet show, nonetheless, significant trace element variations, reflecting biotite and Y-REE-P-rich accessory phase breakdown during partial melting reactions. Peritectic garnet and cordierite growth resulted in the preservation of Th- and Y-rich prograde suprasolidus monazite, which constrains the timing of partial melting of the metapelitic protolith at ca. 356.8 ± 2.4 Ma. The zircon cargo further shows that a significant amount of zircon crystals from previously crystallized felsic melts were also remobilized and erupted. These were likely stored in an upper crustal pluton that grew episodically since ca. 390 Ma during voluminous melt generation periods within the middle to lower crust, which also resulted in voluminous volcanism. The geochemical trends of the felsic volcanic rocks reflect the entrainment of xenoliths of peritectic garnet, cordierite and feldspar, and as such, the garnet-bearing felsic volcanic rocks represent an erupted mixture of a lower-temperature (ca. 770 °C) silicic melt and autocrysts, and peritectic phases and zircon crystals from previously crystallized and stored felsic melts.

Keywords Peritectic garnet · Prograde monazite · Peraluminous rhyolites · Petrogenesis · Iberian Pyrite Belt

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