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# Origin and significance of garnet from South Apuseni Neogene dacite and andesite porphyries (Romania): Insights from major and trace element composition

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Calc-alkaline dacite and andesite-hosted garnets from five volcanic complexes in the South-Apuseni Mountains, (Romania) have been analysed for major and trace element compositions. Garnets are anhedral to subhedral, showing disequilibrium features. Their mineral inclusion assemblage consists of plagioclase, apatite, oxides, and zircons. Major element profiles reveal that garnets have small to absent compositional zoning and are almandine-pyrope solid solutions with lesser grossular and spessartine components ($Alm_{59-63}Pyr_{12-20}Gros_{12-15}Spes_{5-13}$). Garnets record crystallisation temperatures from $750^0$C in Brad and Stanija intrusions to $840^0$C in Almasul-Mare intrusion. All these characteristic properties of the analysed garnets point to a magmatic origin as early-crystallising phase directly from the magma at depth. Subsequent transport towards shallower crustal levels resulted in disequilibrium conditions that led to their partial resorption and development of reaction coronas. A small subpopulation of the analysed garnets contains inherited peritectic cores and igneous overgrowths that record their formation during a partial melting event in the deep crust and subsequent incorporation in the ascending magma, that allowed for magmatic garnet overgrowth. The composite garnets display a pronounced chemical zoning with trace element depleted cores and enrichments in the rims by up to an order of magnitude. The incongruent melting reaction recorded by the peritectic garnet most probably occurred through biotite and amphibole breakdown in a source rock of magmatic parentage, as evidenced by the major element composition of the cores and mineral inclusion texture and relationship. Rare composite garnets have been identified. They consist of magmatic garnet mantle (with similar geochemical features as the other analysed phenocrysts), enveloping a resorbed core of pelite-derived metamorphic garnet, characterised by low grossular component and HREE content, and high P, Sc, Zr and L-MREEs.

Thus, the occurrence of garnets in the South-Apuseni Neogene magmas involves three fundamental different processes, namely the more pervasive fractional crystallisation (type-1 garnet, present in all studied intrusions), the selective entrainment of peritectic phases from a partial melting event involving intermediary to mafic (meta)-igneous source rocks (type-2 garnet, occurring in Almasul-Mare intrusion), and minor assimilation of meta-sedimentary fragments at deep crustal levels (evidenced by scarce metamorphic cores of some garnets in Stanija intrusion, type-3 garnet).