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Garnet growth history in granulites from the southeastern Moldanubain Zone (Bohemian Massif) revealed by Zr in rutile thermometry, mineral inclusions and trace element zoning

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The zirconium content in rutile, which is commonly enclosed in garnet core and rim areas, is strongly temperature dependent and thus has been used to constrain the temperature of garnet growth from core to rim in UHT granulites from the Gföhl nappe, Moldanubian Zone. In addition, trace element zoning and a systematic investigation on mineral inclusions in garnet crystals of the felsic and mafic granulites from the Dunkelsteinerwald, Pöchlarn-Wieselburg and Zöbing area in the southeastern Moldanubian Zone (Lower Austria) enable us to reconstruct the garnet growth history. Both felsic and mafic granulites contain conspicuous garnet major element zoning pattern that show a strong coincidence with their trace element zoning patterns. They display a broad and chemically homogeneous high-grossular garnet core coinciding with nearly flat zoning patterns in trace elements. In turn, the thin rim parts of the garnet grains show a pronounced zoning with dramatic changes in major and trace elements. High-Ti biotite inclusions and Zr thermometry of single rutile grains enclosed in garnet cores indicate that the majority of the high-grossular garnet cores were formed at temperatures in the range of 800-850 °C. This reflects that either (1) the garnet cores started to nucleate spontaneously at conditions considerably above the equilibrium isograd reaction during prograde rock evolution or (2) garnet cores crystallized at high temperatures directly from a melt. The dramatic drop in P, Ti and Zr and the simultaneous sharp increase in V, Cr and Ga at the thin garnet rim parts marks a significant change in the garnet forming reaction compared to the garnet cores. Inclusions in these strongly zoned garnet rims include crystallized melt and white mica relics indicating that these garnets grew by incongruent melting reactions involving white mica during a near isobaric heating phase. Zirconium thermometry of rutile inclusions, texturally assigned to these garnet rim regions, indicate an UHT imprint at about minimum temperatures of 950 °C.

Keywords: Bohemian Massif, Moldanubian Zone, homogenous high-grossular garnet cores, strongly zoned garnet rims, significant change in the garnet forming reaction, UHT imprint