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Genesis of felsic and mafic HP granulites from the Moldanubian Zone, Lower Austria

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The granulite occurrences from the Moldanubian zone were extensively studied in the last three decades and their metamorphic overprint at high pressures and at UHT conditions are well constrained. However, there are still some discrepancies regarding the prograde PT-path evolution, the genesis of the granulites and the tectonic processes required to produce the proposed PT-paths. Here we present a comprehensive petrological study where we have investigated more than 300 granulite samples from one of the largest occurrences, the Poechlarn-Wieselburg area - Dunkelsteinerwald. Conventional geothermobarometry, garnet zoning pattern, thermodynamic modelling and Zr-in-rutile thermometry on rutile grains enclosed in garnets in felsic and mafic granulites allowed to constrain the prograde as well as the retrograde segments of the PT path. Polycrystalline melt inclusions and high-Ti biotite relics as well as a uniform temperature of approximately 800°C obtained from rutile inclusions (Zr-in-rutile thermometry) in garnet cores disagree with a continuous prograde garnet growth but favour a metastable overstepping of the garnet-in reaction and growth by the peritectic biotite breakdown reaction to garnet and melt within a very narrow PT interval. Subsequent heating to T>1000°C initiated a second stage of garnet growth with a very distinct chemical composition. The preservation of the zoning pattern at these metamorphic conditions clearly document a very short lived process. Diffusion models predict a time span of <5 Ma and cooling rates of 50-60°C/my. Zircon U-Pb ages usually cluster around 340 Ma representing the metamorphic peak. However, in mafic granulites zircon ages from approximately 410 Ma to 340 Ma are obtained indicating either an older formation age for the precursor rock of the mafic granulites or just documenting the occurrence of xenocrysts. We applied a series of coupled petrological–thermomechanical tectono-magmatic numerical model to reproduce our deduced PTt-path that evolved from exhumation of subducted lower crust followed by intense heating at the crust-mantle boundary.