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P-T-t evolution of pelitic gneiss in the Lhenice shear zone (Moldanubian Zone of the southern Bohemian Massif).

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The Moldanubian Zone of the Bohemian Massif is a unique metamorphic belt, as both ultrahigh-pressure (UH*P*) and ultrahigh-temperature (UH*T*) metamorphic rocks are exposed together. The occurrences of UH*P* metamorphic rocks have been reported from several areas of the Moldanubian Zone (e.g. Becker and Altherr, 1992; Becker, 1996; Kotkova et al., 1997; Vrana and Fryda, 2003; Nakamura et al., 2004; Kobayashi et al., 2008; Faryad, 2009; Naemura et al., 2009a, b, 2011; Kotkova et al., 2011). Recently, multiple equilibrium stages were identified from Grt-rich gneiss at Ktis in the Lhenice shear zone, located along the western margin of the Blansky les massif (Kobayashi et al., 2011). The characteristic matrix mineral assemblage of the Grt-rich gneiss is Crd + Sil + Bt + Grt +/- Spl with Qtz + Kfs +Pl. Ky is only identified as an inclusion phase in the rim of Grt. Tiny CO_2-N_2 fluid inclusions are abundant in the core of Grt but are free from in the rim. The geothermobarometory, based on the mode of occurrence of constituent minerals and the zoning pattern of Grt, depicts the following developing history of the host rock, such as a prograde stage defined by the assemblage of Grs-rich Grt core (Grs=27) + Pl (An_{11-15}) under 1.5-2.3 GPa at 700-900 ^{o}C (Stage 1), a subsequent Grt-rim forming stage represented by Ca-poor Grt (Grs_5) + Pl (An_{12-19}) + Ky/Sil at 730-830 ^{o}C and 1.0-1.3 GPa (Stage 2), and a following decompression stage by the outermost rim of Grt (Grs_2) + Sil + Crd +/- Spl at 740-850 ^{o}C and 0.6-0.8 GPa (Stage 3) (Kobayashi et al., 2011). To evaluate ages of multiple equilibrium stages, chemical Th-U-Pb isochron method (CHIME) Mnz age dating was carried out for Grt-rich gneiss. Mnzs included in the core of Grt show bimodal grain size; coarse-grained (1 mm in diameter) and fine-grained (10 micrometer in diameter). Mnzs included in the rim of Grt have fine-middle grained size (10 micrometer to 0.5 mm in diameter). Mnzs in the matrix have middle-coarse grained size (0.5 mm to 3 mm in diameter). Most of middle-coarse grained Mnzs show a chemical zoning; relatively low Th constant in the core and high Th content in the rim. The Mnz grains included in the core of Grt give an average age of 337.2+/-4.2 Ma. The Mnz grains included in the rim of Grt give that of 336.5+/-5.1 Ma. The Mnz grains in the matrix give 334.9+/-3.9 Ma. Similar ages around 340 Ma are reported by U-Pb zircon ages of high-pressure granulite (e.g. Aftalion et al., 1989; Kroner et al., 2000; Slama et al., 2008) in the southern part of the Bohemian Massif. These results suggest that the studied rock experienced very fast exhumation from stage 1 to stage 3. Furthermore, felsite inclusions are found from the core and rim of coarse-grained Grt. Felsite inclusions are composed mainly of micrometre- to submicrometre-scale spherulitic and granophyric intergrowths of quartz and feldspar (alkali feldspar or plagioclase). These features of the inclusions are similar to those of ”nanogranites” which are felsic inclusions enclosed within Grt in high- to ultrahigh-temperature pelitic migmatites and/or granulites as reported by Cesare et al. (2009) and Hiroi et al. (2011). Cesare et al. (2009) concluded that nanogranites are the crystallized anatectic melts which were trapped by peritectic minerals growing during partial melting. The felsite inclusions in this study suggest that partial melts formed during early high-pressure metamorphic stage (stage 1) and trapped by garnet have undergone nonequilibrium crystallization under specific conditions of continuous rapid cooling.

Keywords: Bohemian Massif, Gneiss, Monazite age, Partial melting, Fast exhumation, Rapid cooling