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Open and closed isotopic system behaviour of monazite and xenotime during crustal melting of metapelitic migmatites

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Partial melting during the exhumation of middle-crustal cordierite-garnet-biotite migmatites of the Pelhrimov Complex, situated in the nort-eastern segment of the Moldanubian Batholith (Czech Republic), led to the formation of S-type granitic magmas. In a quarry near Vanov (S. Bohemia), paragneiss which are the source of the S-type granites are perfectly exposed along with heterogeneous migmatite and granitic pods, stocks and dykes. This unique assocation allows us to study directly the link between the source and the resulting felsic liquid.

Monazite and xenotime grains were sampled from four different lithologies: (A) stromatitic migmatite containing up to 10 vol% of melt fraction; (B) diatextite with ubiquitous relics of old gneiss components, also termed "dirty granite", (C) cordierite-bearing leucogranite pods, and (D) homogeneous portions of biotite granite. Backscatter images of monazite grains reveal patchy zoning in most cases. Monazites from lithologies A and B contain old cores, whereas monazite from lithology D show rarely oscillatory zoning in marginal portions or have a near-homogeneous texture. Xenotimes show simple concentric zoning with mostly oscillatory outer zones and homogeneous, with sometimes non-planar zones in the cores.

U-Pb dating techniques were applied to resolve the sequence of melting reactions, using both high-precision ID-TIMS and in-situ SIMS methods. SIMS-analyses from centers of monazite grains from lithology (A) revealed a primary crystallization age of 487 $\pm$ 8 Ma, while largely scattering whole-grain ID-TIMS ages can be volumetrically modelled as a mixture of these cores and 328 Ma old rims. The average 207Pb/235U ID-TIMS ages of lithologies (B) and (D) are indistinguishable at 328.0 $\pm$ 0.5 Ma, but show significant scatter beyond analytical precision. The presence of an older lead component was verified by SIMS analyses ranging from 330 $\pm$ 5 up to 348 $\pm$ 5 Ma. Xenotime from lithology (C) forms a perfect lead loss line from the $\sim$330 Ma to zero.

From these data we conclude: 1) Monazite remained stable during reactions forming melt in the stromatitic migmatite and only shows overgrowth; 2) monazite in lithologies B and D contain traces of an old lead component that survived the melting reactions; 3) melting occurred close to the age of the nearby Mrakotin granite (Zak et al., 2011; 327.0 $\pm$ 0.3 Ma, CA-ID-TIMS U-Pb on zircon); 4) the open system behaviour leading to recent lead loss in xenotime is currently unexplained.