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Combining high precision and high spatial-resolution U-Pb geochronology to unravel the duration of anatectic systems: an example from the Grenvillian Orogeny

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Determining the duration of anatectic systems in ancient mountain belts is a daunting task. Zircon grains are generally zoned, such that high spatial-resolution geochronological methods are required, but these are commonly not precise enough to unravel Precambrian events, such that a high-precision method is required. Herein, we present an example of such strategy applied to three leucosome and leucogranite specimens from a section of the Allochthon Boundary Thrust (ABT) northeast of the Manicouagan Reservoir. First, cathodoluminescence imaging and LA-ICP-MS analyses were conducted to determine the isotopic and trace elements characteristics of the different zones in zircon grains extracted from the specimens. We then selected 3-5 grains representative of the different zones identified in each sample, removed them from their epoxy mold, cut them when necessary, and dated them using the high-precision CA-ID-TIMS method. A leucosome in a stromatitic paragneiss from the footwall of the ABT, showing no macroscopic evidence of solid-state deformation, returned five concordant ages ranging from 999.59 ± 0.67 to 990.6 ± 0.65 Ma, indicating at least nine million years of zircon crystallization in a partially melted gneiss. Zircon grains from a syn-deformation leucosome in the hanging wall returned two ages (4 analyses) of 1001.41 ± 0.64 and 998.28 ± 0.47 Ma. These zircons are depleted in heavy rare earth elements, indicating growth after or synchronous with garnet growth, but before the isothermal decompression path associated with garnet decomposition (see Dasgupta et al. this conference). A granitic dyke cutting across the mylonitic foliation of this same outcrop, showing a ductile-brittle deformation transition, returns an age (two analyses) of 989.3 ± 0.6 Ma. Deformation and isothermal decompression of the high-pressure belt in the hanging wall of the ABT is therefore well constrained between 1001 and 990 Ma, synchronous with partial melting of Parautochthonous Belt rocks in the footwall. The anatectic system of the last phase of this Proterozoic orogen was therefore active for at least 12 million years, which is similar to the duration documented in Phanerozoic equivalent.