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Pressure-Temperature-time-deformation path from the Allochthon Boundary Thrust of the Central Grenville Province: Implications for mid-crustal exhumation during the late phase of the Grenvillian Orogeny

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Despite the Allochthon Boundary Thrust (ABT) being the main tectonic discontinuity in the Grenville Province in eastern Canada, no modern Pressure-Temperature-time-deformation (P-T-t-d) path is available. Herein, we reconstruct such a path from a garnet + clinopyroxene mafic orthogneiss hosting a hornblende-bearing leucosome, collected from a well-exposed outcrop along the ABT in the central Grenville Province. Three stages of metamorphism are determined from phase equilibrium modelling conducted on local bulk compositions extracted from millimetre-scale quantitative chemical maps. Stage 1 is characterized by the absence of plagioclase and a sub-eclogitic Ca-rich garnet-and Na-rich clinopyroxene assemblage that yields a minimum estimate of 1600 MPa and 800ºC. Stage-2 is characterized by the assemblage of diopsidic clinopyroxene + plagioclase symplectic intergrowth around garnet that yields ca. 1100-1200 MPa and 830-850ºC. Stage 3 is characterized by amphibole + plagioclase coronae around resorbed garnet that yield ca. 900 MPa and 670-700ºC. The overall PT path is thus of heating above the solidus at high-pressure followed by a steep decompression-heating phase between stages 1 and 2, during which garnet is expected to break down, followed by a relatively gentler decompression-cooling phase toward the solidus between stages 2 and 3, for which amphibole and plagioclase are expected to grow during melt crystallization. Preserved domains of stage-1 assemblage present a sigmoidal geometry compatible with the upper-plate to the foreland sense of shear documented at this mylonitic outcrop. The hornblende-bearing leucosome crosscuts the foliation but is slightly deformed. CA-IDTIMS U-Pb ages of 1001.4 ± 0.6 and 998.3 ± 0.5 Ma on HREE-poor zircon from the leucosome indicate crystallization after significant garnet growth and before significant breakdown, hence constraining the timing of stage 1 and early deformation. A granitic dyke crosscutting the mylonitic foliation, but presenting evidence for brittle-ductile deformation, yields an age of 989.3 ± 0.6 Ma. These results indicate that the ABT in the central Grenville Province carried the Allochthonous Belt from lower to middle crustal levels between 1001 and 989 Ma, which is compatible with ductile extrusion above a basement ramp during the late phase of the Grenvillian Orogeny.