# Deposition, metamorphism, exhumation: the geodynamic evolution of metasedimentary rocks in the western Cape Breton Highlands, Nova Scotia, Canada

Travis McCarron and Chris McFarlane

*Department of Earth Sciences, University of New Brunswick, Fredericton, New Brunswick E3B 5A3, Canada*

<*travis.mccarron@unb.ca*>

The Jumping Brook Metamorphic Suite (JBMS) of the western Cape Breton Highlands forms an inverted metamorphic sequence that underwent Barrovian-style metamorphism in the Late Silurian-Early Devonian. Although the age of magmatism in the Aspy terrane is fairly well constrained and basic pressure (P)-temperature (T) estimates are available for the JBMS, little is known about: (1) the depositional age of the JBMS and/or the relationship between the JBMS and adjacent plutons; (2) the conditions and style of prograde P-T paths; and (3) the timing of prograde/retrograde metamorphism. To address these lingering questions, U-Pb detrital zircon and metamorphic monazite and apatite datasets were integrated with model P-T paths determined from major element zoning in garnet. Detrital zircons in a metaquartzite from Corney Brook suggest that the JBMS was largely derived from the adjacent Bras d'Or terrane, further supporting the close spatial link between the Aspy and Bras d'Or terranes in the Cambrian and Ordovician. The maximum age of deposition is constrained to ~540 Ma by the youngest concordant zircon population. Reconnaissance dating of monazite in the medium- and high-grade portions of the JBMS yielded ages of 388 ± 2 Ma and 401 ± 1 Ma respectively. These ages are interpreted to reflect monazite growth during prograde metamorphism, and constrain metamorphism in the JBMS to the Early Devonian. Although diachroneity is observed in monazite across the metamorphic field gradient, apatite, regardless of metamorphic grade, yield overlapping U-Pb ages. When regressed together on a semi-total Pb/U isochron (n = 98), a lower intercept age of 370 ± 4 Ma (MSWD = 1.19) is determined. This age is interpreted to reflect rapid cooling of the JBMS through ~400–500°C. Using the THERIA_G software, P-T paths of metamorphism were determined for the garnet- and staurolite-zones of the JBMS. Model results indicate that metamorphism occurred along tight, clockwise P-T paths and that the style of P-T path was similar in both the garnet and staurolite zones. Peak conditions of metamorphism in the garnet and staurolite zones were ~560°C and 7.4 kbars, and ~580°C and 8.2 kbars respectively. For each model P-T path, the peak P and T are attained simultaneously. This observation along with monazite ages, which increase with metamorphic grade, apatite ages, which are the same regardless of metamorphic grade, and the presence of inverted isograds, suggests that the JBMS underwent a period of rapid tectonic cooling, exhumation, and isograd inversion following peak metamorphism.

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