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Protracted melt-present deformation during the Rigolet phase of the Grenvillian Orogeny. Insights from geochronology along the highway 117 transect through the Grenville Province in western Quebec, Canada

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ABSTRACT

In this contribution we use U-Pb zircon geochronology to investigate the age of melt-present deformation within the various structural levels of the Mesoproterozoic Grenville Orogen that are exposed along the Highway 117 transect in western Quebec, Canada. Samples include six syn- to late-deformational felsic leucosomes and injected veins. Four of them are physically linked with hornblende-bearing leucosome in their host gneiss and all six contain undeformed quartz grains, implying they were deformed while still partially molten. Zircon from all samples reveal complex morphologies defined by inherited cores and successions of texturally distinct zones, that mostly share trace element characteristics and yield overlapping Grenvillian $^{207}Pb/^{206}Pb$ weighted mean ages between ca. 1020–968 Ma. A crustal panel charactered by pervasive migmatites that present evidence for protracted suprasolidus deformation, are key characteristics of channel flow during the youngest phase (Rigolet) of the Grenville Orogen. Field data also indicate that, coeval to deformation in the lower structural level, felsic dykes brecciated mafic components within the upper level; these components were subsequently incorporated into the ductile channel as decametre-sized mafic boudins. Our findings are comparable to recent models advocating Rigolet ductile flow within the Parautochthonous Belt in eastern Quebec but differ from the current conceptual models viewing proposed for the evolution of the orogen during this phase.

1. Introduction

Continental collisional orogens are dynamic and complex tectonic systems that played vital roles in remolding the Earth's crust. Their dynamic nature commonly results in the preservation of spatially and temporally distinct, deformation and metamorphic histories, across the orogen. Knowledge of how and when deformation was accommodated within different parts of these orogens (Cottle et al., 2015) is thus, critical to feeding the ever-shifting scientific understanding of how mountain belts evolve, particularly those that straddle the transition between ancient (e.g. Precambrian) and modern (e.g. Phanerozoic) tectonic regimes (cf. Sizova et al., 2014; Weller and St-Onge, 2017).

Conceptual models for collisional convergent orogens are broadly subdivided into two end-members on the basis of their increasing temperature (T) and magnitude (M): small cold orogens (low-*T*-M) and large-hot and long-duration orogens (LHO; high *T*-M) (Beaumont et al., 2006; Jamieson and Beaumont, 2013). Whereas the tectonic processes leading to burial and exhumation within small cold orogens are largely considered to be dominated by critical taper theory, processes within LHOs have been the focus of topical debate (see Jamieson and Beaumont, 2013; Cottle et al. 2015 for detailed reviews), mostly due to opposing models derived from either critical taper or channel flow theories (e.g. Searle et al., 2007, 2017; Kohn, 2008; Gervais and Brown, 2011; Simony and Carr, 2011). Critical taper theory is based on the maintenance of a critical angle of taper within an orogenic thrust-wedge by processes such as basal accretion, foreland-ward thrust propagation and/or thinning by normal-sense faulting and erosion (Platt, 1986; Dahlen, 1990). Rocks are coupled through the evolution within the

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