Garnet and Zircon petrochronology provide new insights on the metamorphic journey of high-pressure terranes in Central Grenville

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Combining ages determined on garnet and zircon is one of the most robust approaches to link petrogenesis, P-T and time, and therefore to unravel the timescales of orogenic processes. In the central Grenville Province, the Manicouagan Imbricate zone (MIZ) is part of the Laurentian lower crust, that was metamorphosed under High-Pressure (HP) conditions during the Laurentia–Amazonia collision in Mesoproterozoic times. In the Western MIZ, the Lelukuau Terrane (LT) is located between the Parautochtonous Belt to the North and orogenic hinterland to the South, metamorphosed during the 1005-980Ma Rigolet phase and Ottawan phase at ca. 1080-1040Ma respectively. The LT mainly consists of Labradorian-age (~1650Ma) mafic suites, with a fringe of aluminous rocks at its southern edge (see the latest review of Indares, 2020).

Two metamafic samples from the Eastern (Mg rich) and Western (Fe-Ti rich) part of the LT were investigated for P-T estimates, U-Pb in situ zircon dating, and Lu-Hf and Sm-Nd garnet dating. Both samples display a similar equilibrated peak assemblage of garnet, clinopyroxene, plagioclase, rare amphibole and quartz ± biotite, rutile, kyanite, apatite and zircon. Pseudosection modelling suggest HP granulite peak conditions between 14 to 18kbar and 800-1000°C, the scarcity of hydrous phases and quartz explaining the lack of partial melting.

Zircon from the Fe-Ti HP granulite shows a minimum magmatic age of ca 1.6Ga, most data being variously disturbed by lead loss and spreading from 1.6 to 0.95Ga, while a lower intercept of sub-concordant date at 1007.8±8.3Ma (MSWD=1.3, N=7) provides the best estimate for the latest high-grade metamorphic event. Lu-Hf dating on garnet yields similar results with some scatter on the isochrons, and garnet-WR model ages reveal two distinct clusters at ca. 1020Ma and 1010Ma. In the two samples, garnet Lu zoning shows an uncommon enrichment in the rims. The Sm-Nd isochrons provide equivalent ages of 1005±13Ma (MSWD=0.25, Fe-Ti rich) and 1003±8.3Ma (MSWD=0.25, Mg-rich), both samples showing classic Sm enrichment in the rims.

The ages determined on garnet and zircon highlight either two garnet growth events at ca. 1020 and 1010Ma or a thermal re-equilibration at ca. 1010Ma. This is the first petrochronological investigation integrating zircon and garnet in the Grenville Province. The results are consistent with a diachronous thrusting propagation from the hinterland towards the orogenic front in the Central Grenville, highlighting a continuum between the Ottawan and the Rigolet phases, and adding a new understanding on the Grenvillian geodynamics.

Indares, A. (2020). Deciphering the metamorphic architecture and magmatic patterns of large hot orogens: Insights from the central Grenville Province. *Gondwana Research*, 80, 385-409