Multiple-system geochronology on Acasta layered gneisses

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Constraining Earth's crust-mantle evolution using isotope tracers requires robust linkage of age- and isotopic data. This task is especially challenging for Hadean and Eoarchean rocks, which are prone to multiple episodes of metamorphic overprinting (e.g. [1] [2]). Similar issues affect zircon grains, as they often carry the isotopic signatures (e.g. Hf and O) of multiple events (e.g. [3] [6]). Kemp *et al.* [7] however have shown that carefully linking U-Pb dates to Hf isotope ratios in zircon (via simultaneous LA-ICPMS analysis) provides a clearer view of pre-3.7 Ga crustal reservoir evolution. Attempting to robustly match ages with the isotope compositions of *whole rocks*, we are investigating several layered gneisses from the Acasta Gneiss Complex (Northwest Territories, Canada) using combined Sm-Nd, Lu-Hf, and Rb-Sr layer- and internal (mineral) geochronology. The resulting isochron dates and initial isotope ratios represent potentially linked datasets that can help constrain the evolution paths of juvenile and secondary crustal reservoirs [8]. In addition, we are also dating zircon populations (U-Pb, LA-ICPMS) within individual layers for comparison. So far, inter-layer isochron dates range up to 4.01 Ga [8], whereas the latest (partial) equilibration among minerals within individual layers occurred much later: 2.4-2.2 Ga (Lu-Hf), 2.3-2.1 Ga (Sm-Nd), 1.76-1.70 Ga (Rb-Sr). Zircon dates range from 2.6 to 3.7 Ga, with a peak at 3.5-3.7 Ga, plus a single 4.0 Ga analysis. Importantly, closed systems can be preserved on the layer scale despite later within-layer mineral resetting and zircon (re)crystallization, whereas internal isochrons and zircon do not reliably date the establishment and closure of larger scale (> a few cm) chemical systems.

[1] Moorbath et al. (2007) *Chem. Geol.* **135**, 213-231. [2] Mojzsis et al. (2014) *GCA* **133**, 68-96. [3] Bowring & Williams (1999) *CMP* **134**, 3-16. [4] Amelin et al. (2000) *GCA* **64**, 4205-4225. [5] Iizuka et al. (2007) *Precam. Res.* **153**, 179-208. [6] Guitreau et al. (2014) *GCA* **135**, 251-269. [7] Kemp et al. (2010) *EPSL* **296**, 45-56. [8] Scherer et al. (2010) *Fall AGU* **V44B**-01.