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The Lu-Hf isotope system in the Acasta gneiss complex (NWT, Canada)

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The Acasta gneiss complex (AGC) is an outcrop of poly-phase Hadean/Eoarchean rocks that records a multi-stage history. We explore the complexities encountered in such an old crustal remnant at the mineral- to outcrop scale and discuss the preservation and disturbance of the Lu-Hf isotope system in these rocks. Twenty-one new Lu-Hf isotope whole rock measurements are used in combination with previous data to show that some samples have been disturbed by metamorphic garnet growth and/or migmatization/mineral segregation while others clearly preserve their Lu-Hf isotope systematics. Two main Archean magmatic events to be identified at around 3600 and 3960 Ma and an almost purely metamorphic event at about 3750 Ma. Least-contaminated gneisses indicate a Lu-Hf isochron age range of 3929 $\pm$ 84 to 3945 $\pm$ 91 Ma for the oldest rocks that range from mafic to felsic. This age discrepancy relative to 3960 Ma is likely due to crust assimilation. This process is significant in both magmatic groups in the AGC as also observed by previous authors. However, our study demonstrates that crustal contamination is widespread but not ubiquitous and, according to assimilation calculations, the least contaminated samples identified here indicate a near-CHUR Hf isotope composition for the mantle source of 3960 Ma group. Comparison between Hf isotopes in >3.9 Ga detrital zircons from North-American Archean meta-sedimentary basins and those in Acasta gneisses indicate a possible connection that would in turn imply that the AGC was volumetrically significant. Analogy with western Australian Hadean zircon bearing meta-sedimentary belts would point out to local effects in early crustal record in favor of progressive (but not continuous) crustal growth as independent crustal segments in the Hadean-Eoarchean.