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New insights into the Acasta Gneiss Complex using detrital zircon in Pleistocene esker systems

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The Acasta Gneiss Complex (AGC) is a ∼2500 km2 Hadean-MesoArchean terrane that contains the oldest known zircon-bearing rocks on Earth. While only roughly 1% of the AGC has been mapped at outcrop scale (∼30 km2), rocks as old as 4.02 Ga (Ga=billion years ago) have already been discovered. To assess the composition and volumetric contributions of rock units in the vast unmapped regions of the AGC, we dated detrital zircons deposited in a deglacial esker system that traverses this region. These zircons were derived from subglacial erosion of AGC rocks by the late Pleistocene Laurentide ice sheet and therefore provide relatively local approximations of the ages of exposed rocks. U-Pb dates on over 2000 zircons from coarse and fine grain-size fractions at six sites along the esker transect yield prominent modes in age distributions, coinciding with known ages of AGC bedrock as well as the adjacent Wopmay Orogen and Slave craton. Distances from sample sites to mapped terrane boundaries suggest minimal transport distances and thus a local origin for esker sediments. Based on modal abundances of zircon U-Pb dates and support by new reconnaissance-scale mapping, we infer that 2.58-2.80 Ga Neoarchean rocks and 3.37 Ga granitoids are a volumetrically significant component of the unmapped AGC. Esker zircons greater than 3.7 Ga are present in most samples at low modal abundance suggesting that Eoarchean and Hadean rocks are a volumetrically minor component of the AGC. However, their presence indicates that undiscovered ancient crustal relics exist in the unexplored regions of the AGC.