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From early juvenile source to late crustal reworking: The evolution of the Saglek-Hebron crust

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The Saglek-Hebron Complex (SHC) in Northern Labrador includes some of the oldest crustal rocks on Earth. This granite-greenstone terrain recorded over one billion years of early magmatic history spanning between ∼3900 Ma and ∼2700 Ma. The SHC is dominated by rocks from the trondhjemite-tonalite-granodiorite suite (TTG) and granites with Eoarchean to Neoarchean crystallization ages. Our results suggest that the earliest Eoarchean felsic crust is derived from a relatively juvenile source, whereas later Neoarchean crust appears to be mainly produced by crustal reworking. The SHC TTG are generally older than the granites and can be separated into multiple generations based on their zircon ages. Zircons from the oldest Iqualuk gneiss yielded a U-Pb age of 3870 ± 8 Ma for the oldest concordant grains. This age is slightly younger, but overlap within uncertainties with the U-Pb age of 3920 ± 49 Ma recently obtained by Shimojo et al. (2016) for zircons of the same lithology. The main TTG unit, the Uivak gneiss, exhibits crystallization ages ranging over an extended period of time between 3794 ± 7 Ma and 3633 ± 8 Ma. Uivak gneisses are mostly tonalitic in composition but comprise distinct Mg-rich tonalites exhibiting clinopyroxene and hornblende. The Uivak gneisses are consistent with derivation from mafic crustal precursors, possibly the Eoarchean mafic supracrustal lithologies comprised within the SHC. Most analysed granites from the SHC are Neoarchean with zircon ages between 2774 ± 9 Ma and 2805 ± 10 Ma with one older sample that appears to have been emplaced at 3606 ± 9 Ma. In-situ Hf isotopic data on zircons from the Eoarchean Iqualuk and Uivak samples yield chondritic to slightly suprachondritic initial εHf values (up to +3), consistent with derivation from an early juvenile Eoarchean component. The later Paleoarchean and Neoarchean felsic rocks yield low initial εHf values, from ∼-2 at 3600 Ma to ∼-15 at 2750 Ma. The Itsaq Gneiss Complex of SW Greenland is commonly correlated to the SHC. Both complexes appear to show similar Eoarchean crustal evolution, but contrary to what is observed in SW Greenland, no juvenile input has been recorded by the youngest Archean granitoids from the SHC. Considering a common crustal evolution for all SHC granitoids, the zircon εHf vs time trend corresponds to a 176Lu/177Hf ratio of ∼0.01, suggesting that the post-3700 Ma felsic crust from the SHC may be mainly produced by crustal reworking of the oldest TTG. The geochemical composition of the high-Mg Paleoarchean Uivak tonalitic gneiss is however inconsistent with reworking of felsic crust, but rather suggests derivation from a mafic precursor. Assuming a 176Lu/177Hf ratio of ∼0.02 for such mafic source would imply the involvement of a Hadean component to produce the Hf isotopic composition measured in the zircons from the ∼3600 Ma Uivak gneiss.