U-Pb and Hf isotopic data from 3.3-4.0 Ga Acasta Gneiss zircon: how reliable are Hf isotopic constraints?

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The Acasta Gneiss Complex, Northwest Territories, Canada, preserves the oldest granitic crust on the planet; the zircons are often complex and retain a multi-stage history including Pb loss, recrystallization, inheritance, and metamorphic overgrowths[1,2]. Published Hf isotopic data often show within sample variability in excess of analytical uncertainty[3]. We are using split stream LA-ICPMS for U-Pb and Hf isotopes on approximately the same volume of zircon, and also coupling CA-TIMS for U-Pb and solution ICPMS for Lu-Hf recovered from dissolved zircon fragments from a suite of rocks ranging in age from ca. 3.3 to > 3.9 Ga.

At least three factors can affect the homogeneity of initial isotopic ratios within a single grain and between grains for a single sample: post-formation disturbance of parent-daughter ratios, mixing of isotopically and/or chronologically distinct reservoirs, and incorrect age assignments. We demonstrate our approach with both relatively simple and complex grain populations in an attempt to understand within and between grain heterogeneity and the effectiveness of coupling CA-TIMS with solution ICPMS. The simplest samples we have worked with indicate increasingly negative ε_{Hf} with time, from -2 at ~3.9 Ga to values around -5 at ~3.5 Ga, consistent with the involvement of older crust in the origin of tonalitic to granitic compositions.

[1]Bowring and Williams (1999). *CoMP*, **134**(1), 3-16 [2]Iizuka *et al* (2007). *Precambrian Res*, **153**(3), 179-208 [3]Amelin *et al* (2000). *Geochim Cosmochim Ac*, **64**(24), 4205-4225