The tungsten isotopic composition of the Acasta Gneiss Complex

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We report high-precision tungsten isotope measurements on well-characterised [1] mafic and felsic samples of the ca. 3960 Ma Acasta Gneiss Complex (AGC; Northwest Territories, Canada). The samples have radiogenic ε^{182}W values between +0.06 to +0.15 (ε^{182}W being the parts-per-10000 deviation of ^{182}W/^{184}W measured in a sample relative to that of NIST SRM 3136). Two ca. 3600 Ma felsic samples have ε^{182}W ~ 0 and are the oldest samples so far documented to have a W isotopic composition indistinguishable from that of the modern mantle. The ε^{182}W data are correlated with ε^{142}Nd [2] and we attribute this variability to incomplete metamorphic homogenisation of the 3960 Ma protolith with more recent material in a 3370 Ma tectono-thermal event. Notably, the positive ε^{182}W anomalies seen in the 3960 Ma AGC samples is comparable to that observed in other early Archean rocks (Isua Supracrustal Belt, Greenland; Nuvvuagittuq Supracrustal Belt, Canada) and the late Archean Kostomuksha komatiites (Karelia). This demonstrates a globally constant signature. We infer that the presence of a pre-late veneer mantle represents the most straightforward interpretation of a uniform distribution of ε^{182}W ~ +0.15 value in Archean rocks of different ages. We show that such a notion is compatible with independent constraints from highly siderophile element abundances in mafic and ultra-mafic Archean mantle-derived rocks. The absence of anomalous ε^{182}W and ε^{142}Nd so far measured in samples younger than ca. 2800 Ma suggests progressive convective homogenisation of silicate reservoirs. The downward mixing of an upper mantle rich in late-delivered meteoritic material during the Archean might account for these combined observations.

[1] Mojzsis *et al*. (2014) *GCA* **133**, 68-96. [2] Roth *et al*. (2014) *G3* **15**, 2329–2345.