The $\varepsilon^{182}W$ isotope composition of the ca. 3920 Ma Acasta Gneiss Complex

M. WILLBOLD[1,3], S. J. MOJZSIS[2] AND T. ELLIOTT[3]

[1]Imperial College London, Earth Science and Engineering, London, SW7 2AZ, United Kingdom; (m.willbold@imperial.ac.uk)
[2]University of Colorado, Geological Sciences, Boulder, Colorado 80309-0399, USA; mojzsis@colorado.edu
[3]University of Bristol, School of Earth Sciences, Bristol, BS1 8RJ, United Kingdom; (tim.elliott@bristol.ac.uk)

The short-lived ^{182}Hf-^{182}W decay system ($t_{1/2}$ ca. 9 Myr) is a useful tracer to investigate accretionary and geodynamic processes on the early Earth. Variable enrichments in $^{182}W/^{184}W$ – expressed in the conventional $\varepsilon^{182}W$ notation – have been documented in Eoarchean crustal rocks. These data were interpreted by invoking either a 'Late Veneer' model [1], or via early Earth differentiation processes_ENREF_2 [2]. Here we report the first $\varepsilon^{182}W$ measurements for rocks from the Acasta Gneiss Complex (AGC), a terrane located on the western margin of the Slave craton in the Northwest Territories (Canada). The AGC is the oldest known crustal domain with primary magmatic ages that are about 3,920 Ma [3]. It is also apparent that these rocks inherited a much older (ca. 4,200 Ma) crustal component [4]. Our samples include granitoid gneisses and plagioclase-hornblende schists that define a range in $\varepsilon^{182}W$ values comparable to those found in rocks from the ca. 3,800 Ma Isua Supracrustal Belt in southern West Greenland, which formed the basis of the 'Late Veneer' model presented in [1]. Using these new values for the AGC in conjunction with previous data, we test the two models for the W isotopic evolution of bulk silicate Earth in the terminal Hadean. Our results provide new motivation in the search for other daughter products of extinct nuclides (e.g. ^{142}Nd) in the AGC.

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Archean Mo isotopic evolution: Comparing the Pilbara and the Kapvaal Cratons

M. WILLE[1], F.KURZWEIL[1], S. EROGLU[1] R. SCHOENBERG[1], N. BEUKES AND M. VAN KRANENDONK[3]

[1]Dept. of Geoscience, University of Tuebingen,Wilhelmstr. 56, 72074 Tuebingen, Germany
[2]University of Johannesburg, Auckland Park Kingsway Campus, 2006, South Africa
[3]School of Biological, Earth and Environmental Sciences, University of New South Wales, Kensington, NSW 2052, Australia

The environmental and geochemical circumstances which led to heavy Mo isotopic signatures in Archaean sediments remains elusive. Sufficiently oxidising conditions, which enable mobility of Mo in its highest oxidation state, are generally seen as one precondition for the formation of such an isotopically heavy Mo seawater reservoir. However, interpretation of temporal changes in Mo isotopic compositions stored within ancient sediments is often hampered by the fact that they are strongly influenced by paleo-environmental conditions during sediment formation. As such, sedimentary Mo isotopic signatures different to that of the continental crust are often only qualitative rather than quantitative indicators of changes in environmental redox conditions.

Here we present Mo stable isotope datasets, published and new data, from different 3.46 to 2.5 Ga old sedimentary environments from the Pilbara (Australia) and Kapvaal (South Africa) Cratons, respectively. Mo isotopic results for ≥2.76 Ga old sedimentary rocks are within the field of continentally derived detritus, indicating insufficient O_2 levels required to oxidize and mobilize this element. In contrast, Mo isotopic signatures in sediments ≤2.7 Ga are isotopically heavier than sedimentary material solely continent derived. Comparing the Pilbara and the Transvaal general trend to heavier Mo isotopic values in Mo isotopic evolution can be seen in both basins approaching 2.5Ga. These heavier Mo isotopic signatures, in conjunction with the apparent elevated concentrations of other redox sensitive elements, such as U and Re, after 2.7 Ga suggests aquatic mobilization of these elements under sufficient O_2 levels. The comparison of Mo isotopic variations in different contemporary environmental sedimentary setting allows us to ascertain the reasons for the observed Mo isotopic fluctuations.

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