Long-term preservation of W isotope anomalies in crustal rocks from the Pilbara Craton, NW Australia

J.TUSCH[1], C.MÜNKER[1], M.JANSEN[1], E. HASENSTAB[1], C.S.MARIEN[1], F. KURZWEIL[1], M.VAN KRANENDONK[2],

[11] Department of Geoscience, University of Cologne, Zülpicher Str. 49b, 50674 Cologne, Germany (*correspondence: jonastusch@gmx.de)

[2]Australian Center for Astrobiology, University of New South Wales, Australia

The record of ^{182}W isotope anomalies in terrestrial rocks has recently been expanded from the Archean to the Phanerozoic. Unfortunately, most ^{182}W isotope studies only provide "snapshots" of the early terrestrial rock record and do not consider elemental W redistribution by secondary processes that would also affect ^{182}W isotope systematics. This might obscure the original W isotope composition of parental mantle sources and can complicate the reconstruction of the secular ^{182}W isotope evolution.

Here, we atttempt to assess the long-term evolution of ^{182}W isotope patterns during the Archean by studying mantle-derived and crustal rocks from the Pilbara Craton, NW Australia. Mantle-derived rocks provide snapshots of the ambient mantle composition, whereas the crustal rocks provide a long-term average of crust-mantle evolution. By combining ^{182}W isotope analyses with high-precision isotope dilution measurements for HFSE, U, and Th, we demonstrate the preservation of primary geochemical signatures in our sample selection, which allows for the reconstruction of the ^{182}W isotope composition of the ambient mantle in NW Australia. Mantle-derived rocks from the oldest Warrawoona Group display uniform excesses and define a mean μ^{182}W of +12.1 ± 2.1 ppm (95% CI). Younger rocks from the the Kelly and Soanesville groups document that ^{182}W isotope anomalies decrease between 3465 and 3340 Ma to ca +5 ppm and vanish by c. 3190 Ma. Diminishing ^{182}W isotope anomalies in the Pilbara Craton are also archived in shales and granitoid rocks, which provide an integration of the lithosphere. These rocks are characterized by a lower ^{182}W isotope anomaly of + 8.0 ± 1.2 ppm (95% CI). Similar to the evolution of mantle-derived rocks, anomalies in granitoids slightly decrease with decreasing age and are higher in less evolved rocks. The origin of elevated ^{182}W isotope compositions in Pilbara rocks, and their decline to modern mantle values, is consistent with a progressive in-mixing of late veneer material, as previously suggested by decreasing PGE depletions in rocks from the same lithostratigraphic units [1].

[1] Maier et al. (2009) *Nature* **460**, 620-623.