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On the analytical ^{183}W effect and the interpretation of terrestrial W isotope variations

GERRIT BUDDE[1,2], GREGORY J. ARCHER[1], FRANÇOIS L.H. TISSOT[2] AND THORSTEN KLEINE[1]

[1]University of Münster, Institut für Planetologie

[2]California Institute of Technology

Presenting Author: budde@caltech.edu

Small (~10 ppm) mass-independent tungsten isotope variations measured for Archean and modern mantle-derived rocks have become the focus of sustained attention, as they provide critical insights into the past and present workings of the silicate Earth [1]. These anomalies are generally assumed to be of radiogenic origin (from ^{182}Hf decay); however, their adequate interpretation is severely hindered by a complex interplay of natural and analytical effects. For instance, based on growing evidence of significant nucleosynthetic W isotope anomalies in bulk meteorites [2], a nucleosynthetic contribution to some of the observed variations cannot be ruled out *a priori*. Moreover, most (MC-ICP-MS) studies reported a significant analytical artifact (hereafter *analytical ^{183}W effect*), manifesting as spurious W isotope variations that reflect an apparent deficit in ^{183}W [3]. A precise and reliable correction of the *analytical ^{183}W effect* is crucial for disentangling and quantifying radiogenic and nucleosynthetic anomalies, but was hampered by major unknowns regarding its nature and origin.

In this study we evaluated high-precision W isotope data from the last decade, and show that the *analytical ^{183}W effect* arises from mass-independent isotope fractionation that is inconsistent with a nuclear field shift effect [*cf.* 4]. Moreover, our results reveal that this artifact is induced during the chemical separation of W, and that its magnitude is primarily controlled by the amount of W that is processed. The observation that the *analytical ^{183}W effect* increases with decreasing amount of W, therefore, resolves apparent inconsistencies between different previous studies; for instance, why it is less pronounced in data obtained by TIMS. At the conference, we will demonstrate how this artifact can be accurately quantified and corrected, and why this is critical for improving our understanding of the accretion and differentiation history of Earth. Finally, we will discuss subtle variations among different W isotope standards, and how the above findings can be used to better constrain the W isotope composition of bulk silicate Earth.

[1] Kleine & Walker (2017) *AREPS* 45, 389-417. [2] Kruijer et al. (2017) *PNAS* 114, 6712-6716. [3] Kruijer & Kleine (2018) *Chem. Geol.* 485, 24-31. [4] Cook & Schönbächler (2016) *JAAS* 31, 1400-1405.