High-precision tantalum isotope measurements of meteorites by MC-ICPMS.

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Tantalum-180 is the rarest observationally stable nuclide in the solar system with a relative abundance of 0.01201 ± 8% and is produced by both the p- and s-process. Some elements with masses similar to Ta display nucleosynthetic isotope anomalies in bulk solar system materials and in leachates of primitive chondrites, e.g. [1]. Such anomalies provide valuable information on the nucleosynthetic pathways in stars, as well as on the evolution of building materials in the early solar system. For Ta however, sufficiently precise measurements have been challenged by the extremely low $^{180}Ta/^{181}Ta$ ratio.

Tantalum was separated from different terrestrial and meteoritic samples by anion exchange chromatography modified from [2], [3] and analyzed for its isotope composition with a Neptune MC-ICPMS. The combination of a $10^{10}\Omega$ amplifier for ^{181}Ta and $10^{12}\Omega$ for ^{180}Ta and ^{178}Hf (^{180}Hf interference monitor) gives the ability to reduce the internal reproducibility below one epsilon-unit for 600ng Ta. Though, the difference in mass bias behavior between Yb (used for external mass bias correction) and Ta, and tailing effects from ^{181}Ta to ^{180}Ta remain challenges. The external reproducibility (2σ) was typically around ±7ε for ca. 80ng of Ta.

First results for chondritic meteorites were indistinguishable within error from terrestrial rocks.

[1] Elfers et al. (2013) Mineral. Mag. 77, 1034. [2] Münker et al. (2001) G³ 12, 2001GC000183. [3] Weyer et al. (2002) Chem. Geol. 187, 295.