Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24312

Analysis of uranium isotopes using the Neoma MS/MS MC-ICP-MS

SEAN R SCOTT, KIRBY P HOBBS, AMANDA D FRENCH, ISAAC J ARNQUIST AND DANIEL L SULLIVAN

Pacific Northwest National Laboratory

Presenting Author: sean.scott@pnnl.gov

Uranium isotopic analysis by MC-ICP-MS has become a common application in a variety of fields, including nuclear, environmental, geologic, and more. Methods that achieve high precision isotope ratios involving the ^{234}U, ^{235}U, and ^{238}U in samples purified by ion exchange are well established. However, in some cases additional trace isotopes (such as ^{236}U) or rapid uranium isotopic analyses in unpurified samples are desired. Analyses of trace uranium isotopes have suffered from poor abundance sensitivity on previous MC-ICP-MS instruments, and analyses of unpurified samples are often hindered by isobaric interferences generated in the plasma. The Neoma MS/MS MC-ICP-MS equipped with a double-Wien filter and collision/reaction cell has the potential to advance these measurements by improving abundance sensitivity and allowing for online gas separations to shift the uranium analyte away from potential isobaric interferences. Here we report on the impacts of improved abundance sensitivity as it relates to the analysis of ultra-trace (fg/g) uranium isotopes as well as our efforts to measure uranium isotopes in unpurified samples using collision/reaction dynamics of the collision cell. The ^{236}U isotope can be measured free from any tailing associated with the adjacent ^{235}U and ^{238}U peaks, although hydride corrections are still required to reach low detection limits ($^{236}U/^{238}U$ in the E-8 range or below). Uranium can be mass-shifted to either monoxides using CO_2 as a reaction gas, or dioxides using O_2 as the reaction gas. Using either gas, the stability of raw uranium isotope ratios is comparable to uranium isotope ratios measured as the metal ions without any gas in the cell. However, the use of reactive gases in the cell creates additional background signals that make analyses of small ion beams on the ion counters problematic. Nevertheless, analyses of the ^{234}U-^{235}U-^{238}U in unpurified samples have been successful when analyzed as metal ions, producing isotopic compositions within 1 % and 10 % of the true value for the $^{235}U/^{238}U$ and $^{234}U/^{238}U$, respectively.