

# Trace actinides in common U reference materials may bias measurements of $\text{UO}_2^+$ by TIMS

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A popular method for measurement of U in U-Pb ID-TIMS is loading individual samples in silica gel on single Re filaments. This allows measurement of both the U and the Pb fractions on the same filament, which is more efficient than using separate runs for each. Under these conditions, the dominant U ion species is  $\text{UO}^{2+}$ , which necessitates corrections for O isotopologues, such as  $^{233}\text{U}^{16}\text{O}^{18}\text{O}^+$  on  $^{235}\text{U}^{16}\text{O}^{16}\text{O}^+$  or  $^{236}\text{U}^{16}\text{O}^{18}\text{O}^+$  on  $^{238}\text{U}^{16}\text{O}^{16}\text{O}^+$ . The most common U double-spike tracer for U-Pb ID-TIMS is  $^{233}\text{U}$ - $^{235}\text{U}$ , and for this combination of isotopes, the apparent  $^{18}\text{O}/^{16}\text{O}$  can either be measured at mass 269 ( $^{233}\text{U}^{16}\text{O}^{18}\text{O}^+$ ) or 272 ( $^{238}\text{U}^{16}\text{O}^{18}\text{O}^+$ ) simultaneous with a sample measurement, for the highest precision oxygen isotope interference correction. Here, I report TIMS  $\text{UO}_2^+$  measurements of CRM-112a (natural uranium), CRM-111a (high purity  $^{233}\text{U}$ ), CRM-U500 (equal atom  $^{235}\text{U}$ - $^{238}\text{U}$ ), and a high-purity  $^{235}\text{U}$ . These measurements are used to explore the consistency of oxygen isotope compositions measured using different sources of U and with different isotopologues. The apparent oxygen isotope systematics of unirradiated (natural U and enriched  $^{235}\text{U}$ ) and irradiated ( $^{233}\text{U}$  and CRM-U500) uranium are different. Irradiated U yields higher apparent  $^{18}\text{O}/^{16}\text{O}$  than unirradiated U, and often has inconsistent oxygen isotopic compositions for the same run when measured at both mass 269 and 272. In contrast, CRM-112a and enriched  $^{235}\text{U}$ , alone or mixed, yield consistent results. For the irradiated materials, patterns of ion beam decay and the presence of persistent ion beams at masses higher than 272 that cannot be derived from  $^{238}\text{UO}_2^+$  strongly suggest that these discrepancies are due to small amounts of Np and Pu in these CRMs that ionize as oxides. Experiment and theory suggest that these interfering elements may not be eliminated during HCl-based anion exchange chemistry, and therefore may be present during normal U-Pb measurements. The magnitudes of the interferences are highly sensitive to specific analytical conditions, but they may be sufficient to bias within-run  $^{18}\text{O}/^{16}\text{O}$  measurements made at masses 269 and 272. Analysts making within-run  $\text{UO}_2^+$  measurements using  $^{233}\text{U}$  derived from CRM-111a (such as ET535 and ET2535) may wish to consider validating that their procedures are not affected by these interferences.