

Isotopic analysis of uranium using high resolution ICP-OES

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This study highlights the potential of high resolution (HR-)ICP-OES for the determination of uranium isotopes. Utilizing its high spectral resolution of less than 5 pm, a commercial HR-ICP-OES instrument was employed for the analysis of various U isotopic abundances in several certified isotopic reference materials and real world nuclear samples. To this end, the HR-ICP-OES instrument was connected to a specifically adapted glove box operated in under-pressure, thus allowing the handling of radioactive samples.

Accurate and precise determinations of samples containing depleted, natural and enriched U were performed at the wavelength region around 424.4 nm, a region that offers the largest spread between individual U emission signals, i.e. ^{233}U , ^{234}U , ^{235}U , ^{236}U , and ^{238}U [1,2]. Reliable quantifications of ^{233}U at 424.398 nm, however, were severely hampered by spectral overlaps of a dominant Th signal (424.393 nm) in spent fuel [2]. Therefore, the assessment of ^{233}U was aimed at emission line at $\lambda=411.585$ nm [2].

The developed analytical HR-ICP-OES procedures were validated using certified isotopic reference materials and/or reference measurements by TIMS or MC-ICP-MS performed in-house in an accredited laboratory [1].

Examples of the analysis of samples containing depleted, natural and slightly enriched U, but also specimens with rather high ^{233}U (~84%), ^{234}U (~11%) or ^{235}U (up to ~90%) abundances will be presented.

In contrast to the commonly used mass spectrometric techniques, the methodology applied in this study for isotopic analyses does neither require separation of U from the matrix prior to analysis nor the regular analysis of a reference sample with a known isotopic composition to correct for bias effects. Nevertheless, HR-ICP-OES provides U isotopic information with reasonable accuracy (typically 1.5%) and precision (~1%) within a few minutes [1]. As such, HR-ICP-OES can be employed as a reliable, fast screening tool to identify the U isotopic composition and as such, complements the more laborious TIMS analysis routinely employed for this purpose.

References

[1] Krachler M, Carbol P (2011) Validation of Isotopic Analysis of Depleted, Natural, and Enriched Uranium using High Resolution ICP-OES, *J Anal At Spectrom* 26: 293-299.

[2] Krachler M, Wegen DH (2012) Promises and Pitfalls in the Reliable Determination of ^{233}U Using High Resolution ICP-OES, *J Anal At Spectrom* 27: 335-339.

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