Evaluating the uncertainties associated to isotope ratio measurements carried out by some mass spectrometry techniques in real uranium samples

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Abstract

An experimental programme was set up to evaluate the uncertainties associated with isotope ratio ($n(^{235}U)/n(^{238}U)$) measurements carried out by the following mass-spectrometry techniques: gas- source mass-spectrometry (GSMS), thermal-ionisation mass-spectrometry (TIMS) and inductively-coupled-plasma mass-spectrometry (MC ICPMS). A group of samples with isotope ratios ranging from depleted (0.5 wt %) to low enriched uranium (3.5 wt %) were selected to enable the comparison of performances on the different machines. Although all the three techniques provided very precise and accurate results, the GSMS always produced results with the smallest combined uncertainty. For the sample with a natural uranium isotopic composition, the combined uncertainty of the value measured by TIMS was 5.7 and by MC ICPMS 2.3 times higher than that measured by GSMS. The stability of the ion beam generated by the electron impact ion source employed in GSMS was regarded as the main reason of this outstanding performance.

Comparative measurement results will be given showing the practical advantages and disadvantages of each of these methods.

***Keywords**: mass-spectrometry, Gas-source, thermal ionisation, Inductively-coupled plasma, uranium isotopics*