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Implementation of the Total Evaporation and Modified Total Evaporation methods to analyses of U isotopes at the Canadian Nuclear Laboratories

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The Canadian Nuclear Laboratories (CNL) has a long history of measuring uranium (U) isotopes by thermal ionization mass spectrometric (TIMS) technique. TIMS analyses at CNL have been performed following the "classical TIMS method", where the different isotopes are collected in a limited period during the sample evaporation and then their respective isotopic ratios are mathematically corrected for mass fractionation. The mass fractionation factor is calculated using the difference between the long-term average of measurements made on CNL's TIMS instrument from certified reference materials and their respective certificate values. However, the mass fractionation may be affected by other parameters (e.g., amount loaded on filament, heating temperatures of the filaments, rate of evaporation, etc.) which can be difficult to reproduce from one analysis to another. To minimize the impact of mass fractionation, the total evaporation (TE) and later the modified total evaporation (MTE) methods were developed and have been implemented for decades on the analysis of isotopic composition of actinides [1,2]. CNL recently purchased a new TIMS from Nu Instruments Ltd. which has capabilities for TE and MTE analyses. This specific instrument is equipped with multiple Faraday cups that can switch between amplifiers, thus increasing the range of signals which can be collected on a Faraday cup and ultimately allowing implementation of new techniques for U analyses. The presentation will discuss the implementation of the TE and MTE methods at CNL using a Nu Instruments TIMS, as well as the use of Faraday detectors equipped with 10^{12} ohm amplifiers, for improving U isotopic measurements and their associated uncertainties.

[1] Fiedler, R. (1995). International journal of mass spectrometry and ion processes, 146, 91-97.

[2] Richter, S., and Goldberg, S. A. (2003). International Journal of Mass Spectrometry, 229(3), 181-197.