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Advancing Cs isotopic measurement by TIMS using ATONA® amplifiers

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Naturally occurring Cs is monoisotopic consisting of ^{133}Cs, however ^{135}Cs and ^{137}Cs are both relatively high abundance fission products of ^{235}U and ^{239}Pu. The measurement of ^{137}Cs has always been of particular interest as it has a relatively short half-life of 30.1 years and presents a hazard from a radiation dose perspective. However, more recently the measurement of ^{135}Cs/^{137}Cs ratios has become a topic of interest. Due to differences in the physical properties of the very short half-life precursor elements in the decay chains that produce ^{137}Cs and ^{135}Cs, Cs isotopic ratios can be used to distinguish between Cs produced as the product of reactor operations and Cs produced by a nuclear detonation. These types of measurements are of particular interest to the Comprehensive Test Ban Treaty Organization (CTBTO) and for nuclear forensic investigations. Cs isotope ratio measurements also have applications in oceanography and in dating of sediment layers. The measurement of Cs isotopic ratios presents challenges common to many isotopic systems like isobaric interferences, but there are less familiar problems such as measuring an isotope system that is naturally monoisotopic and has limited reference materials certified for isotopic composition. Here we present work that seeks to advance the capability to measure Cs isotopic ratios by TIMS by exploring the limits of detection for Cs and developing static routines for measuring Cs isotope ratios. Initial work using our SEM peak-hopping TIMS analytical method demonstrated that in 100 attogram (^{137}Cs) loads the ^{135}Cs/^{137}Cs ratio could be measured with better than 1% external reproducibility. Preliminary abundance sensitivity data will be presented which suggests the ^{137}Cs limit of detection for the TIMS equipped with a WARP energy filter and secondary electron multiplier could be less than a single attogram of ^{137}Cs. Finally, we present the development of a new total evaporation protocol that leverages the extreme dynamic range of the ATONA amplifiers and shows promise for measuring larger Cs loads with large (> 50 V) ^{133}Cs ion-beams and very small (< 5000 cps) ^{137}Cs and ^{135}Cs ion beams.

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