Contribution ID: **425** Type: **Interactive Content Presentation**

EVALUATING RADIOCHRONOMETRY BY SINGLE COLLECTOR MASS SPECTROMETRY FOR NUCLEAR FORENSICS: A MULTI-INSTRUMENT STUDY

EVALUATING RADIOCHRONOMETRY BY SINGLE COLLECTOR MASS SPECTROMETRY FOR NUCLEAR FORENSICS: A MULTI-INSTRUMENT STUDY

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Radiochronometric age constraints are a foremost signature in assessing the provenance and processing history of nuclear material out of regulatory control. When possible, the application of multiple radiochronometers can provide increased confidence for interpreting age-dating results in a nuclear forensic examination. Radiochronometric data has traditionally been acquired via multicollector mass spectrometry, a relatively expensive and sophisticated analytical technique. We therefore explored the potential of performing age-dating by single collector mass spectrometry. If achievable, single collector radiochronometry would be a valuable contribution given these instruments'widespread availability compared to multicollector mass spectrometers, thereby expanding radiochronometry to a broader range of the international forensic community. Such a development would ideally result in the increased acquistion of accurate and reliable age information that will further bolster the global response to nuclear interdictions.

Our approach to evaluating the feasibility of this technique for radiochronometry consisted of a multi-instrument intercomparison experiment, in which single and multicollector mass spectrometers were used to characterize uranium certified radiochronometry standards in parallel. The exact same radiochronometry samples, isotopic tracers, quality control reference materials, and data reduction algorithms were used in both the production and processing of data generated by each instrument, allowing for direct comparison of isotopic and age-dating results amongst the various mass spectrometer designs. Our findings clearly demonstrate that single collector mass spectrometry can be successfullly implemented to obtain high quality radiochronometric data. Certified radiochronometry standard ages and isotopic data from single collector instruments are consistent with those from multicollector instruments. While multicollector mass spectrometers ultimately generate the most precise radiochronometric and isotopic data, single collectors can be used to accurately constrain the age of nuclear material.

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Track Classification: MORC: Nuclear forensics