Improving U and Pu isotope analyses by HR-MC-ICPMS

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For a variety of applications, (i.e. nuclear nonproliferation, geologic and environmental studies), the need for increased throughput and higher precision isotope ratio measurements on small sample quantities is paramount. In particular, the ability to measure small deviations from natural U isotopic ratios and the separation of Pu from complex matrices, especially those containing U is of great importance. With the onset of multi-collector ICPMS, new techniques that move away from traditional thermal mass spectrometry are being developed.

We have made initial tests using a Thermo-Finnigan Neptune on both U and Pu isotopic standards in order to determine our "reasonable" detection and precision limits. A variety of techniques for the effective measurement of small differences (+3 to -3 delta) in the $^{235}U/^{238}U$ of U-standards at varying concentrations were compared. These include both external and internal standards and both regular and desolvating nebulizers. Similarly, internal and external standard techniques have been used to determine how best to increase precision and accuracy of Pu isotope measurements. In addition, initial results have been obtained with a hyphenated technique employing electrochemically modulated separation (EMS) on-line with MC-ICPMS to improve the speed, sensitivity, and selectivity of a novel separation and analysis process for plutonium. The EMS-MCICPMS combination allows for effective separation of Pu from the matrix for solutions of up to 20:1 U:Pu and should greatly increase the efficiency of sample output.

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