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High Precision Isotope Ratio Analysis of Sub-nanogram Samples Using MC-ICP-MS

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The isotope ratio precision of low concentration samples can be limited by the type of detectors used in their measurement. Multiple-collector ICP-MS (MC-ICP-MS) routinely achieves isotope ratio precisions of lower than 0.002% RSD for elements such as lead, neodymium and hafnium. To obtain this, Faraday detectors are used and the isotopes are measured simultaneously to overcome ion beam instability. However, Faraday detectors and the associated electronics have a typical noise level of $2x10^{-16}$ amps RMS (over 5 seconds). This results in poorer precisions being measured for low ion beam intensities due to the decrease in the signal to noise ratio.

Single ion-counting multipliers are advantageous in measuring isotope ratios of smaller sample quantities. This technique requires peak jumping or scanning across each isotope. To achieve the best precisions it is essential that good beam stability and fast mass jump speeds are available. For solution analysis, relatively good beam stability is possible and with instrument features such as electro-scanning, mass jumps can be made in micro-seconds. Utilizing both of these methods can produce isotope ratio measurements in the 0.05 - 0.01% RSD range.

For analysis of even smaller sample quantities or less stable ion beams originating from introduction methods such as laser ablation, the recent development of multiple multiplier systems offer a lot of potential for achieving good isotope ratio precisions. These systems have the advantages of low noise levels and are tolerant of unstable and transient ion beams.

The VG Axiom MC ICP-MS has the capability to employ all of the above techniques in the measurement of isotope ratios. Recent work on its multiple multiplier system has shown multiplier/multiplier and Faraday/multiplier stability of less than 0.15% over 8 hours (Figure 1).

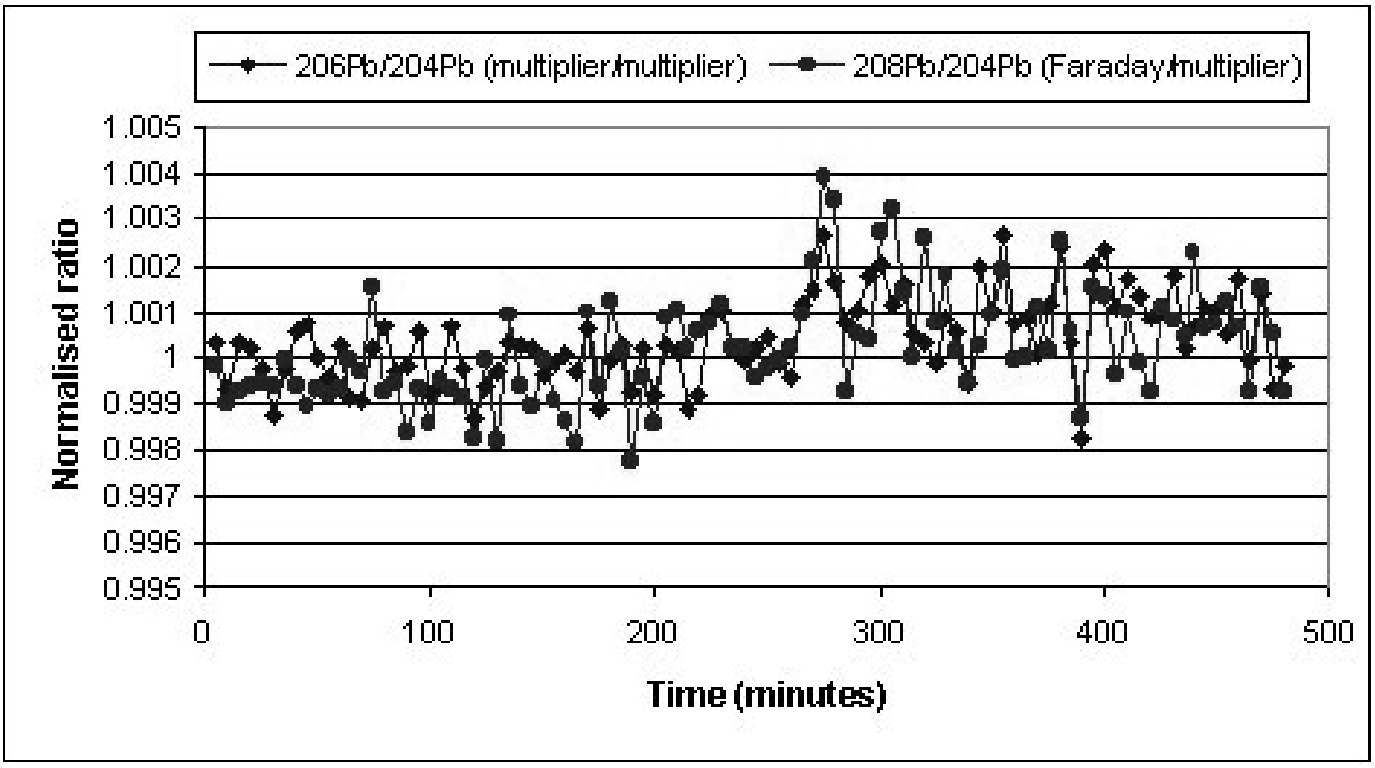

Figure 1: Isotope ratio stability of the VG Axiom Multiple Multiplier system