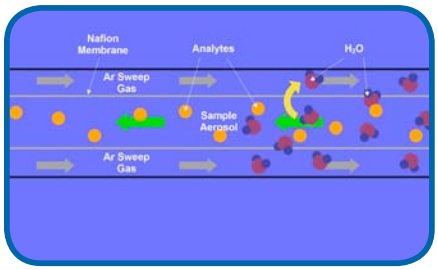
Ca Isotopes Ratios with Apex-ACM

Introduction

The determination of three calcium isotopes in biological samples is necessary for human metabolic isotopic tracer studies. Here we use the Apex-ACM to reduce interferences on the 42, 43 and 44 isotopes of calcium in oxalate precipitated samples and determine the ratios in low-resolution.



Apex-ACM

The Apex produces uniform dry aerosol that is further desolvated by the ACM where solvent vapors pass into the Nafion® membrane and are removed by sweep flow of a dry gas.

Operating Parameters

Free aspirating µ-Flow-100 nebulizer and Apex-ACM are used for interference reduction and optimal signal stability. Plasma noise is reduced on the ELEMENT-1 by settling the magnet at the start mass (42) and electrostatically scanning the isotopes of interest. Best precision is obtained on stable flat top peaks in low resolution.

Interferences and Blanks

Spectral interferences originate from doubly charged $^{86}Sr^{++}$ on ^{43}Ca, $^{88}Sr^{++}$ on ^{44}Ca and polyatomic ions. The doubly charged ions are corrected by measuring $^{87}Sr^{++}$ at half mass 43.5. The majority of polyatomic interferences on Ca isotopes are water based with the most significant being $^{40}ArH_2^+$ on ^{42}Ca. By reducing the water load by approximately 2 orders of magnitude the Apex-ACM decreases the combined blank and interference contribution to less than 0.5% of a 10 ppm Ca signal for all 3 isotopes (**Fig 1**).

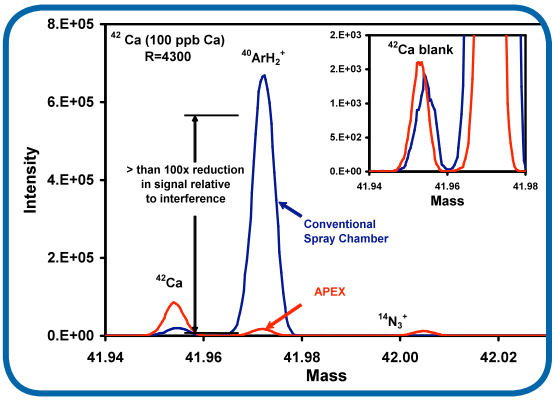


Fig 1: Improved Ca isotope measurements with Apex (red) compared to a conventional spray chamber (blue).

Precision

The short-term precision is determined for eight two-minute acquisitions (n=8) of Ca isotope ratios (**Fig 2**). Error bars represent the precision (1-std) of each analysis, dashed and solid lines indicate the 1 and 2 standard deviations of the data set. The data indicate that better than 0.04% (1-std) precision.

Long-term Stability

During long runs of ppm levels of Ca, both signal intensity and isotope ratios drift due to cone deposition. This is significant and can be as much as 50% in sensitivity and 1.4% in isotope ratio over the course of 8 hours. Short term precision indicates standards can be run every 6th unknown with less than 0.05% drift between standards, requiring a small sample-sample correction (<0.02%). Bracketing samples with standards at this interval results in long term precision of less than 0.1% (1-std).

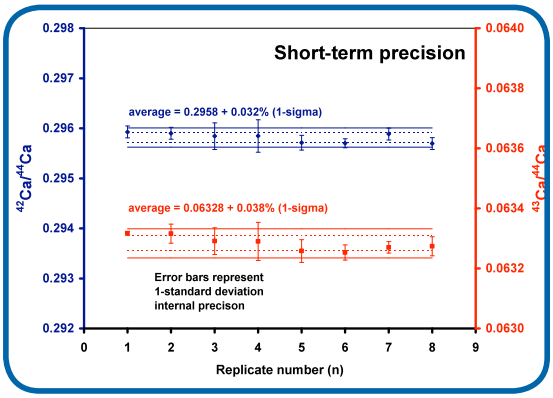


Fig 2: Stability data for Ca isotopes. Data indicate 0.04% (1-std) precision.

Conclusions

The Apex-ACM reduction of interferences and with signal stability allows for the low resolution determination of Ca ratios isotopic tracer studies.

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