

Isotope 2: Precision, stability and throughput improvement in Ca isotopes

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Multiple-collector inductively-coupled plasma mass spectrometry (MC-ICPMS) has revolutionized geochemistry, anthropology, forensics, and human health over the last 25 years. For solution analysis, the standard introduction system is self-aspiration which introduces an air bubble as the autosampler probe moves between samples.

A combination of the Apex Omega with an Isotope 2 autosampler obviates these changes in plasma load. The Isotope 2 employs a syringe pump for precise control of flow rate and dual calibrated sample loops; a standard or another sample can be loaded while one sample is being analyzed. This eliminates uptake and washout time, optimizing efficiency and throughput of samples on expensive MC-ICPMS platforms. Flow rates can be individually modified in the Neoma software, eliminating the need laborious manual dilutions for optimal sample-standard voltage matching. The Isotope 2 has a fluorowand automated system to reduce sample evaporation and a ULPA filter and dual rinse station to reduce blank and carryover. The Apex Omega has a dual desolvation system, including a Peltier-cooler and an EPTFE fluoropolymer membrane desolvator, further reducing the matrix load at the plasma.

Calcium isotopes are measured at higher concentrations if collision cell techniques are not employed, as ⁴⁰Ar interferes on ⁴⁰Ca. Calcium ion beams are measured in medium resolution, requiring additional sample to compensate for reduced sensitivity and making it particularly sensitive to matrix effects. Further, applications in biomedicine including astronaut bone health, osteoporosis, and cancer metastasis demand high sample throughput [1-3]. We evaluate the improvement in precision, sample throughput, and short- and long-term mass bias stability in calcium isotopes with the combination of Apex Omega and Elemental Scientific, Inc., Isotope 2 on a Thermo Finnegan Neoma with an earlier generation Apex Q and SC-DX autosampler.

[1] Gordon, G.W. *et al* (2025) NASA HRP meeting [2] Eisenhauer *et al* (2024) *Bone* **188**, 177210. [3] Gordon *et al* (2014) *Leukemia* **28**, 2112-5.