Calcium isotope determination with the Nu Sapphire Dual-Path MC-ICP-MS

YE ZHAO [1]*, JUSTIN I. SIMON [2]

[1]Nu Instruments Ltd, Unit 74, Clywedog Road South, Wrexham Industrial Estate, LL13 9XS, UK (* correspondence: ye.zhao@ametek.com)

[2]NASA, Johnson Space Center, 2101 E NASA Pkwy, Houston, TX 77058, USA (justin.i.simon@nasa.gov)

Calcium (Ca) isotopes in primitive meteorites and rocks from Earth, the Moon, and Mars can be used to provide information on early solar system processes and planetary differentiation. High precision Ca isotopic measurements are often performed on the Multi-collector ICP-MS (MC-ICP-MS) due to its high ionizaion efficiency and fast sample throughput. However, this technique is limited by the presence of the large $^{40}Ar^{+}$ ion beam which prevents the measurement of $^{40}Ca^{+}$. Ar-based polyatomic species also interfere on other Ca isotopes and need to be resolved using high mass resolution. In addition, there can be baseline scattering contributed by the $^{40}Ar^{+}$ beam.

In this study, the Nu Sapphire, a novel MC-ICP-MS instrument equipped with a dual-path design including both a conventional MC-ICP-MS (high-energy) path and a collision cell (low-energy) path, is used for Ca isotopic measurements. Following extraction of the ions from the ICP at 6 kV, the ions are deflected off-axis and decelerated to enter the collision cell. In the cell, the ions mix with He and H_2 gases to remove interfering species and are then re-accelerated to 6 kV and focused back onto the high-energy path. The collision cell will greatly benefit high precision Ca isotopic measurements, as the technique enables efficient removal of Ar-based spectral interferences, which not only makes the direct measurement of $^{40}Ca^{+}$ possible, but also avoids the need to use high resolution, reducing the sample size by an order of magnitude.

In this study, a range of silicate minerals will be analyzed against the SRM915a standard using the Sapphire collision cell. The same samples have also been characterized by double-spike thermal ionazation mass spectrometry at NASA Johnson Space Center. As such, the analyses demonstrate in detail the capability of the Nu Sapphire MC-ICP-MS to provide accurate and precise Ca isotopic data at high sample throughput for natural samples.