# Measuring geological and biological potassium stable isotope ratios with Proteus collision cell MC-ICP-MS

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Given potassium's abundance, its distribution in nature and its essential functions in eukaryotic cells, K stable isotopes have a high potential for studying geological and biological systems. However, the measurement of $^{41}K/^{39}K$ ratios has long been a challenging task for exploration of natural K isotope variability. Although opening new horizons for the determination of isotope ratios, the advent of MC-ICP-MS did not initially solve these challenges, with K isotope analysis being severely hampered by $Ar^+$ scattering and $ArH^+$ interferences. While high-resolution, cold plasma approaches have recently provided means to circumvent these complications [1], collision cell MC-ICP-MS has also been shown to allow the sufficient suppression of Ar based interferences to enable the precise measurement of $^{41}K/^{39}K$ ratios [2].

Here we present a method for measuring K stable isotope compositions using the Thermo Scientific™ Proteus™ collision/reaction cell MC-ICP-MS prototype (developed in collaboration between the Bristol Isotope Group and Thermo Fisher Scientific). This new generation instrument is double-focusing and so allows the collision-cell to be independently optimised for reduction of interferences.

We have developed an ion-exchange chromatography procedure allowing purification and total recovery of K. Several cell conditions were tested, including previously described $He/H_2$ mix. This allows the nearly total suppression of Ar interferences enabling $^{41}K^+$ and $^{39}K^+$ to be measured in low mass resolution. We have determined $\delta^{41/39}K$ values in a series of IAPSO, USGS, NIST and JRC geological and biological reference materials, with SRM3141a as a bracketing reference material. The method yields an analytical precision of ≤ 0.10‰ (2 SD). Comparison of our results with literature shows good agreement with both cold plasma and collision cell methods. This work demonstrates the potential of Proteus for the study of thus far poorly described biological cycling of K isotopes.

**[1]** Morgan et al., *JAAS*, 2018; Hu et al., *Chem. Geol.,* 2018; Chen et al., *JAAS*, 2019, **[2]** Wang & Jacobsen, *GCA*, 2016; Li et al., *JAAS*, 2016