# High precision $^{41}K/^{39}K$ measurements by MC-ICP-MS indicate terrestrial variability of $\delta^{41}K$

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Measurements of non-conventional stable isotope systems have been critical to developing our understanding of past and present ocean chemistry. Of the major cations found in seawater, potassium has remained until recently as the only multi-isotopic element without demonstrated geologic isotopic variability. This apparent lack of geologic variability can be ascribed to the difficulty of measuring stable K isotopes with sufficient precision and sensitivity.

TIMS measurements of $^{41}K/^{39}K$ are hampered by variable fractionation patterns and the lack of sufficient K isotopes for internal spiking, leaving TIMS analyses appropriate for e.g., identifying excess $^{41}K$ [1] but not for measuring absolute $^{41}K/^{39}K$ values. Previous work using SIMS analyses has yielded precisions of 0.25‰ [2], which did not clearly identify terrestrial fractionation.

A largely unexplored method for K stable isotope measurement is ICP-MS, due to isobaric interferences of $^{40}ArH^+$ and $^{38}ArH^+$ at the major K masses 41 and 39, respectively. Our technique, involving wet cold plasma (ca. 600 W) and high-resolution slits on a Thermo Fisher Scientific NEPTUNE *Plus* MC-ICP-MS instrument, has been used to measure $^{41}K/^{39}K$ values in a range of geological and biological materials with an external reproducibility of ca. 0.17‰ (2σ). Measurements of $^{41}K$ were made on narrow but flat peak shoulders on the combined $^{41}K$ and $^{40}ArH^+$ peak. The use of cold plasma can enhance non-isobaric matrix effects [3]; tolerances of $^{41}K/^{39}K$ to potential contaminating elements have been thoroughly tested.

$\delta^{41}K$ values for seawater are centered around 0‰, which is defined by NIST SRM999b. Seawater is found to be ca. 0.6‰ heavier than the mean value for high-temperature silicate rocks and mineral separates, a result similar to that of [4]. Results from a range of high- and low-temperature rocks will be presented.

[1] Wielandt & Bizzarro (2010), JAAS 26, 366-377. [2] Humayun & Clayton (1995) GCA 59, 2115-2130. [3] Bryant et al. (2003) JAAS 18, 734-737. [4] Wang & Jacobsen (2016) GCA 178, 223-232. Li et al. (2016). JAAS, 31(4), 1023-1029.