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High precision analysis of potassium stable isotopes using the collision/reaction cell Neoma MC-ICPMS/MS

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Potassium isotopes hold great promise for tracing geological processes, but their analyses are fraught with complexities. Several methods using different generations of MC-ICPMS instruments have been developed, including (i) “cold” plasma coupled with high resolution (e.g., [1]), (ii) extra high resolution (e.g., [2, 3]), and (iii) collision/reaction cell (CRC) technique (e.g., [4]). Recently, a new generation of double-focusing MC-ICPMS with CRC has been introduced, notably the Sapphire from Nu Instruments and the Neoma MC-ICPMS/MS from Thermo Scientific. Several previous studies have reported test results of K isotope measurements on the Sapphire (e.g., [5]), revealing extreme sensitivities of the measurements to tuning conditions, matrix effects, and concentration/acid molarity match between samples and standards.

In this study, we conducted tests to measure K isotopes using the Neoma MC-ICPMS/MS to investigate its potential. Sapphire instruments are equipped with dual ion paths, featuring a conventional high energy path and a low energy path for CRC operation. In contrast, Neoma MC-ICPMS/MS has a single ion path but includes an additional MS/MS (mass shifting) component alongside CRC.

We used wet plasma for our tests. The precision achieved was ~0.03 to 0.1 ‰ (95% c.i.) for 5–25 measurements of standard solutions in a single analytical session, comparable to other established techniques. The measurements were accurate within the tested concentration range of 50–500 ppb K. A concentration mismatch of up to 5% was acceptable, while mismatches in acid molarity had a pronounced effect on the measured K isotopic composition. Matrix elements did not significantly impact K isotopic measurements if their concentrations remained below 2% of K. Several geostandards were measured, and the obtained values agree with those from other measurement techniques. Overall, Neoma MC-ICPMS/MS is highly sensitive to tuning, necessitating considerable effort for K isotopic measurements.

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