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Copper isotope compositions measured using the Collision/Reaction Cell (CRC)-MC-ICP-MS Sapphire

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Copper has two stable isotopes, ^{63}Cu and ^{65}Cu, with natural abundances of 69.2% and 30.8%, respectively. The isotopic composition of this transition metal has been extensively used in Earth Sciences to trace magmatic and redox processes (e.g., [1]). Its isotopic composition is also used in biology as biomarker, to trace changes in Cu homeostasis induced by diseases such as liver cirrhosis or neurodegenerative diseases for instance (e.g., [2]). The challenge in analysing biological samples is the higher amount of data usually required for robust interpretations and the more intricate matrices compared to geological samples, such as increased sodium content. This necessitates a more time-consuming chemical separation process prior to measuring Cu isotopes.

Measuring Cu isotope compositions in biological samples with the Sapphire CC-MC-ICP-MS could overcome this challenge by utilising a He-H_2 gas mix in the Collision/Reaction Cell (CRC) to eliminate the sample matrix-based $^{40}Ar^{23}Na^+$ interference on $^{63}Cu^+$. This could potentially reduce the need for extensive chemical separation procedures.

By employing He at 2 ml/min and H_2 at 5 ml/min in the CRC, the Sapphire CC-MC-ICP-MS demonstrates sensitivity for Cu greater than 50 V/ppm in wet plasma. Analyses were conducted using a 500 ppb pure Cu solution, with a standard-sample bracketing procedure and a total acquisition time of 200 s per analysis. Under these conditions, the short-term repeatability achieved for $d^{65/63}Cu$ is routinely better than 0.05‰ (2 SD). The matrix effect is being evaluated by adding Na to a pure Cu solution with no $^{40}Ar^{23}Na^+$ interference forming up to Na/Cu ratios of at least 10. Potential matrix effects on Cu isotope fractionation in the plasma will be evaluated.

Hopefully these tests will demonstrate the Sapphire ability to accurately measure Cu isotope compositions in high Na samples, such as some biological samples, through a streamlined chemical processing procedure. Data collected from mice brain samples for which we already measured the Cu isotopic composition [2] will be presented at the conference to further test this technical approach on natural samples.

[1] Moynier et al. (2017), RIMG 82, 543-600. [2] Moynier et al. (2022), Metallomics 14.