



## Determination of U-isotope composition of silicate and carbonate reference materials for in-situ LA-ICPMS analysis by high precision MC-ICPMS

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U-series isotope analyses are frequently used in order to constrain the timing and duration of climatic, environmental and geological processes during the past 600 ka. In addition to the commonly applied TIMS and MC-ICPMS techniques, in-situ methods such as LA-ICPMS have recently been developed in order to resolve spatial variability in the U-isotope composition of carbonate and silicate materials (e.g., Mertz-Kraus et al., 2010).

A prerequisite for the application of LA-ICPMS for U-isotope measurements is the availability of matrix matched, homogeneous reference materials with precisely established U-isotope composition. These are, for instance, required in order to control instrumental and matrix induced biases occurring during analysis. Here we report high-precision MC-ICPMS U-isotope ratios for various solid reference materials, especially produced for in-situ micro-analysis (KL2-G, BCR-2G, ATHO-G, ML3B-G, GSD-1G, BHVO-2G, MACS-3).

The analyses were performed with the NU plasma MC-ICPMS at the Max Planck Institute for Chemistry, Mainz. Samples were dissolved in an HCl-HF mixture, and U was separated following traditional chemical separation and purification procedures. The analytical protocol for MC-ICPMS analysis utilizes a common standard-bracketing procedure in order to derive correction factors for mass fractionation and Faraday cup-SEM gain.

Analyses of four splits of GSD1-G yielded  $^{238}\text{U}/^{235}\text{U}$  and  $^{234}\text{U}/^{238}\text{U}$  ratios in agreement within uncertainty demonstrating the homogeneity of the material (mean values:  $271.39 \pm 0.3$  and  $0.000017982 \pm 49$ , respectively). The  $^{238}\text{U}/^{235}\text{U}$  and  $^{234}\text{U}/^{238}\text{U}$  ratios of the naturally sourced KL2-G ( $140.96 \pm 0.28$  and  $0.00005322 \pm 51$ , respectively) are significantly different from the ratios determined for the original KL2 rock powder ( $137.45 \pm 0.28$  and  $0.00005493 \pm 18$ , respectively), which is assumed to be caused by U contamination during glass preparation. BCR-2G and ATHO-G have natural  $^{238}\text{U}/^{235}\text{U}$  within error. Whereas the  $^{234}\text{U}/^{238}\text{U}$  ratio of BCR-2G is slightly higher than the value expected for secular equilibrium, the  $^{234}\text{U}/^{238}\text{U}$  ratio of ATHO-G agrees with the secular equilibrium value. The  $^{234}\text{U}/^{238}\text{U}$  ratios for ATHO-G and BHVO-2G are in agreement with the TIMS values determined by Matthews et al. (2010). Preliminary analyses of ML3B-G and BHVO-2G and the corresponding rock powders suggest  $^{238}\text{U}/^{235}\text{U}$  ratios in the range of the natural ratio and  $^{234}\text{U}/^{238}\text{U}$  in the range of secular equilibrium. The synthetic carbonate reference material MACS-3 has a non-natural U-isotope composition ( $^{238}\text{U}/^{235}\text{U} = 373.42 \pm 0.43$ ;  $^{234}\text{U}/^{238}\text{U} = 0.00001350 \pm 87$ ). The available  $^{234}\text{U}/^{238}\text{U}$  data indicate a potential inhomogeneity of MACS-3. This will be investigated by further analyses.

Precise determination of U-isotope ratios in widely distributed geologic reference materials will facilitate the application of in-situ methods such as LA-ICPMS for analysis of U-series isotopes in a wide range of geologic materials.

### References

Matthews et al. (2010) Geostandards and Geoanalytical Research DOI: 10.1111/j.1751-908X.2010.00080.x  
Mertz-Kraus et al. (2010) JAAS, 25, 1895-1904.