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B isotope ratio measurements by LA-MC-ICP-MS in waters, ablated as solid evaporite samples

MICHAEL J. PRIBIL[1], DANNY RUTHERFORD[2], JARED L. CARTE[1], SHAUN J DONMOYER[1] AND BRUCE HENSEL[3]

[1]US Geological Survey
[2]U.S. Geological Survey
[3]EPRI

Boron consists of two isotopes, ^{10}B and ^{11}B and has been reported to exhibit a range in $\delta^{11}B$ from -18 to 60‰ in natural waters. The isotopic composition of boron in water samples is typically measured by thermal ionization mass spectrometry (TIMS) following sample pretreatment. Multi-collector inductively coupled plasma mass spectrometry (MC-ICP-MS) is increasingly being utilized to measure boron isotope ratios; however, challenges associated with boron sample introduction adds complexity to measuring B isotope ratios. Laser ablation (LA)-MC-ICP-MS measurements have been reported in solid samples, and one research paper documented the measurement of boron isotope ratios in liquid samples by LA-MC-ICP-MS in solutions.

The ablation process for liquid samples requires meticulous care during sample loading, special consideration ablating liquids, and challenges ablating through parafilm. We developed a method to measure boron isotope ratios in water samples as evaporites. This method involves adjusting samples to a neutral or slightly basic pH, evaporating water samples and NIST 951 in a laminar clean hood, reconstituting the evaporated samples in a minimal volume of water, transferring to a 1-inch round epoxy puck and drying at ambient temperature. Five shallow tracks were created in each epoxy mount using a drill press, with the cell sample holder capable of accommodating nine 1-inch round mounts. We used NIST 610 to bracket USGS GSE-1G for instrument tuning and initial laser ablation introduction validation and observed an average $\delta^{11}B$ value of 1.60‰ (0.62 SD) agreeing with the reported value of 1.63‰ (0.32 2SD). Several previously analyzed water samples were also analyzed with OY-4 resulting in an average $\delta^{11}B$ of -16.71‰ (0.47 SD, n=22) compared to a reported value of -16.94‰, and OY-2 resulted in a $\delta^{11}B$ value of -3.48‰ (0.86 SD, n=8) within the uncertainty of the TIMS reported value of -4.12‰. We will present additional data along with detailed information regarding the challenges and lessons learned for our new fit-for-purpose method for measuring boron isotope ratios in natural, leachate, and pore water samples as evaporites by LA-MC-ICP-MS. We will also investigate, and if successful, present results of additional isotope systems in evaporites using LA-MC-ICP-MS.