



Assessing Gol-e-Zard Cave (GZS) and Bergen Speleothem Standards (BSS) for U/Th Geochronometry Using MC-ICP-MS

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Recent advancements in MC-ICPMS technology have significantly enhanced the application of U/Th geochronometry in both biogenic and chemically precipitated carbonate rocks of almost middle Pleistocene to upper Holocene. This burgeoning use, particularly in the study of late Pleistocene earth surface processes, underscores the need for standardized reference materials with a broad age spectrum with different uranium and thorium concentrations. Addressing this need, our study evaluates speleothem specimens, Gol-e-Zard Cave Standard (GZS) and Bergen Speleothem Standard (BSS), as potential reference materials.

BSS-2 was processed as a homogenized powder and dissolved aliquot for U-Th dating using MC-ICP-MS analysis. We employed various digestion and ion-resin chromatography separation methods, followed by U-Th dating using MC-ICP-MS at CENIEH, University of Miami, and University of Mainz. The ion chromatography protocols yielded recovery rates ranging from 85% to over 95%. U-series analyses of powdered BSS-2 indicated uncertainties between 0.2-1.5%, attributed to variations in the Beta-factor and the specific U and Th standard bracketing procedures used across laboratories. The dissolved BSS-2 aliquots yield between 1.5-2% of uncertainty. Obtained U-Th ages were 122.8 ± 3.3 ka (University of Miami), 124.5 ± 0.3 ka (University of Mainz), and 123.9 ± 3.2 ka (CENIEH) in the powdered samples. Furthermore, in dissolved samples, the Th-ages vary between 126.9 ± 2.9 to 127.9 ± 3.1 (CENIEH & University of Miami). GZS was prepared as a dissolved standard and the Th-date results obtained from this stalagmite are 3967 ± 0.1 to 3988 ± 0.1 (University of Miami), and 3967 ± 0.1 to 4060 ± 0.4 (CENIEH).

All Th-dates required no correction as activity ratios [$^{230}\text{Th}/^{232}\text{Th}$] exceeded 500 and 150 for BSS-2 and GZS, respectively. The consistency of these preliminary results across different laboratories suggest that GZS and BSS-2 are promising reference materials for U-Series analysis of calcium carbonate.

