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Towards high precision and low ratio ^{10}Be measurements with the SUERC 5MV tandem : bigger isn't always better

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We quantify the uncertainties, total system efficiency, and interlaboratory reproducibility of ^{10}Be measurements on the SUERC 5MV spectrometer. Secondary standards have average statistical uncertainties based on counting statistics of 0.6%, 1.0%, and 1.3% for standard materials with ratios of 3×10^{-12} (N=144), 1×10^{-12} (N=86), and 6×10^{-13} (N=81), respectively. The average measured ratios fall within the reported 1.1% uncertainty. The error-weighted standard deviation is 1.5%, 2.6%, and 2.6%, respectively. These data indicate an additional uncertainty of 1.4-2.4% above counting statistics. Furthermore, we measured 11 replicate quartz targets. These full-chemistry replicates have an average uncertainty of 1.2%, but a standard deviation of 3.6%. We also determined the minimum ionization and total system efficiency to be 0.3% and 0.1%, respectively. ^{10}Be samples prepared by chemistry laboratories in the US and measured at SUERC had high and consistent beam currents, $105 \pm 5\%$ (1 SD) of the primary standards, indicating the high quality of chemistry (high $\sim 100\%$ Be yield and pure BeO as verified by ICP-OES data on final Be fractions). The consistently low carrier blanks (6×10^{-16}) demonstrate the sensitivity of the SUERC system. Measured 1-sigma analytical uncertainties were 3% for low 10^{-13} , 5-12% for 10^{-14} , and 14-19% for low 10^{-15} ratio samples. An AMS laboratory intercomparison of 3 quartz samples ranging from $\sim 3 \times 10^{-14}$ to $\sim 1 \times 10^{-13}$ are reproducible within their reported uncertainties. In the same experiments, we measured exposure ages of about $1.4 \text{ ka} \pm 100\text{-}200$ years. These results demonstrate the effectiveness of the SUERC 5MV spectrometer, including potential for high precision and low ratio ^{10}Be analyses.