Paper No. 11
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OPTIMIZING SAMPLE PREPARATION FOR HIGH-PRECISION, LOW-DETECTION LIMIT ANALYSIS OF IN SITU ^{10}BE: STRATEGIES AND NEW DATA

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Optimizing laboratory methodology for the preparation of ^{10}Be samples has a direct positive effect on data quality. Methodological optimization can be implemented in any laboratory, and produces purer samples that perform more consistently during accelerator mass spectrometry (AMS). Tracking sample composition throughout the laboratory procedures (e.g., by using ICP-OES) provides quality control. Optimization strategies that can have large benefits include testing quartz purity, verifying the performance of column chromatography, testing final Be yield and purity, and minimizing background ^{10}Be levels.

For the ~800 samples prepared following optimization of University of Vermont procedures in 2009, ICP-OES measurements of the final beryllium column fraction indicated that little Be was lost during processing; final Be yields were ~95% of the original Be load in the sample (added through a ~250 µg ^{9}Be spike). Al, Fe, and Ti, which are known to decrease the efficiency of AMS if present in the Be fraction, were effectively removed during column chromatography, leaving <20 µg of each elemental impurity. Samples ran on the Lawrence Livermore National Laboratory AMS with an average $^{9}Be^{3+}$beam current of 21.4 ± 3.9 µA (n = 814), and performed as well as the standards; the ratio of sample beam currents normalized to beam currents for the first run of all standards was 1.0±0.2.

96 of the samples analyzed in this experiment were cobbles embedded within the Greenland Ice Sheet (GIS). These samples had very low ^{10}Be concentrations and most would not have been measurable before methodological optimization. Background ^{10}Be levels were minimized by using beryl ^{9}Be carrier produced at UVM and repeatedly run as a process blank ($4.2 \pm 1.7 \times 10^{-16}$, n = 22), using dedicated labware and hood space for low-level samples, and counting blank cathodes to near exhaustion on the AMS. The GIS samples had $^{9}Be^{3+}$ beam currents of 23.3 ± 3.4 µA, measured ratios from 4.2×10^{-16} to 2.7×10^{-13}, and ^{10}Be concentrations of several hundred to several thousand atoms per gram. This case study suggests that methodological optimization targeted at producing high-precision, low-detection limit samples is a prerequisite to addressing scientific questions involving ^{10}Be analysis of very young samples, long-buried samples, or profiles with high erosion rates.

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