SMALL PARTICULATE CONTAMINATION STUDY OF GENESIS FLIGHT SAMPLE 61423

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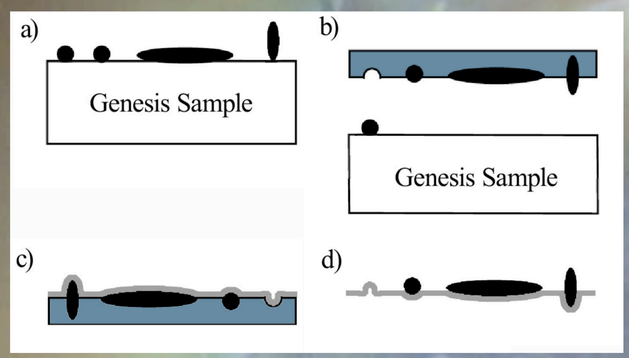
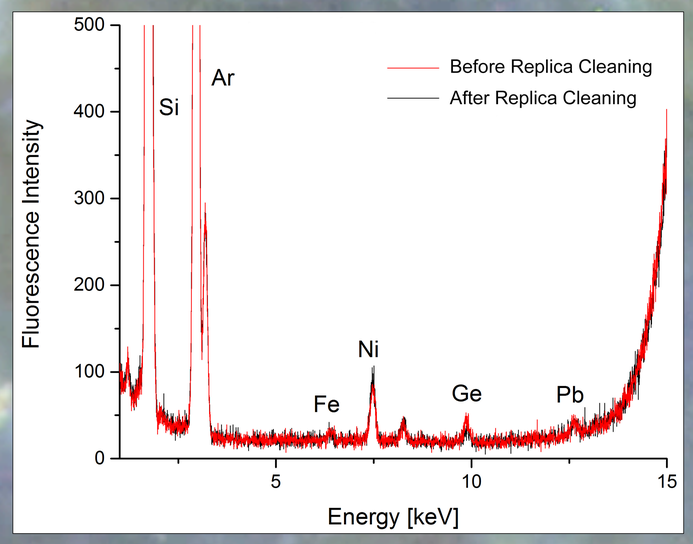
Cleaning History of Genesis Sample 61423: We have performed an extensive iterative study of cleaning procedures on Genesis sample 61423, a piece of CZ silicon from the B/C array. Optical imaging was performed at NASA JSC following each step. The sample was cleaned at NASA JSC prior to each analysis [1, 2]. After TRXRF analysis, the sample was cleaned using two cellulose acetate extraction replicas, as described previously [3]. The sample was returned to Loyola University for a post-replica analysis using TRXRF. The sample was then extensively imaged using secondary electron microscopy (SEM) with energy dispersive X-ray spectroscopy (EDS), with particular emphasis on finding small particles remaining in areas that appear "clean" under optical microscopy. A final analysis was performed using TRXRF.

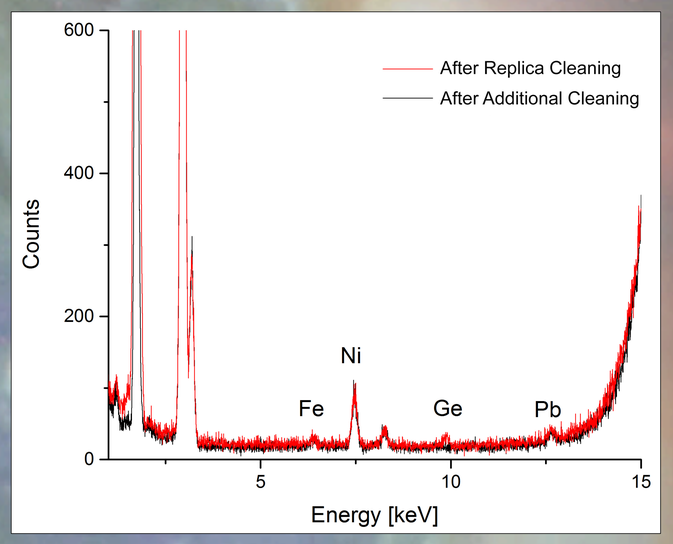
Schematic of Cellulose Acetate Cleaning Technique



a) Genesis samples were returned covered with particles from the crash site and spacecraft. b) A thin film of cellulose acetate is wetted with acetone and applied to the sample. Once dry, the film hardens and is easily removed from the substrate, taking most of the particles with it. c) The freestanding cellulose film can then be coated with 60 nm of evaporated carbon for SEM analysis. d) The acetate film can then be evaporated using acetone vapor to dissolve the cellulose acetate film, leaving a carbon film suspended on a copper TEM grid containing the particles removed from the Genesis sample.

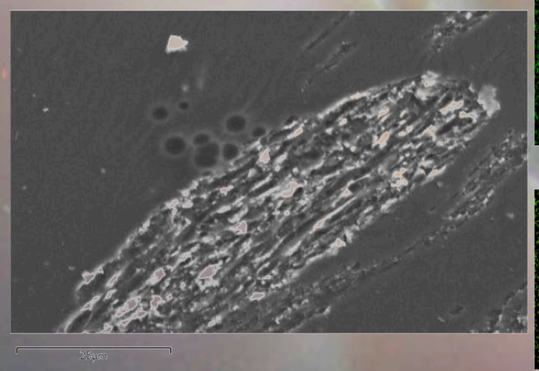
TRXRF Analyses of Genesis Flight Sample 61423



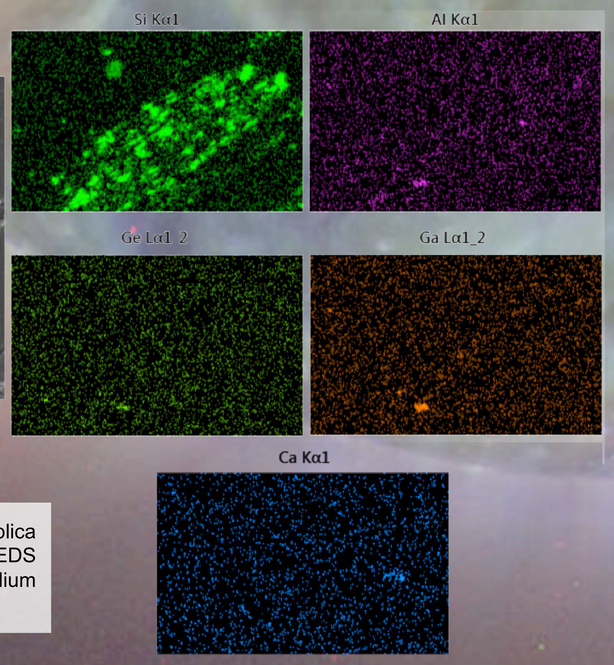


We performed TRXRF analyses to determine if the cellulose acetate extraction replicas leave any residue that might interfere with large area solar wind analyses. TXRF is a surface sensitive analytical method with detection limits in the lower ppb to upper ppt range. Its non-destructive nature makes it an ideal tool for repeated surface observation of Genesis samples, e.g. after different cleaning procedures were applied to the samples. In TXRF an incident X-ray beam strikes the mirror-like surface of the sample at an extremely small angle and is totally reflected. Trace contaminants on the surface will generate fluorescence, which is recorded with a Si-drift fluorescence detector. Elements from aluminum onward are accessible with this method. Analyses before and after the application of the replicas are shown in on the left. The third spectrum taken after further IPA and UPW cleaning is shown on the right for comparison. **Two observations can be made. First, it does not appear that the extraction replicas leave contamination on the surface that would skew large area analyses. Second, multiple cleaning steps appear to reduce the germanium contamination on the surface.**

EDS Mapping of an Extraction Replica of 61423

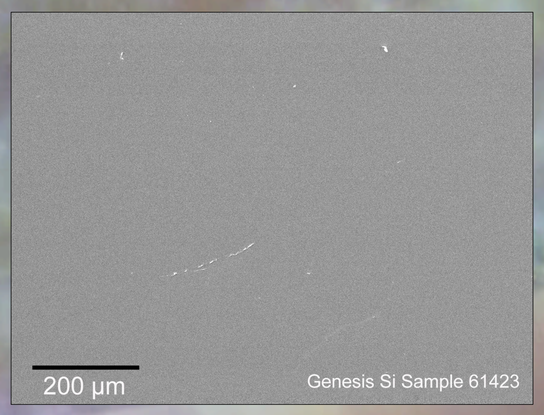


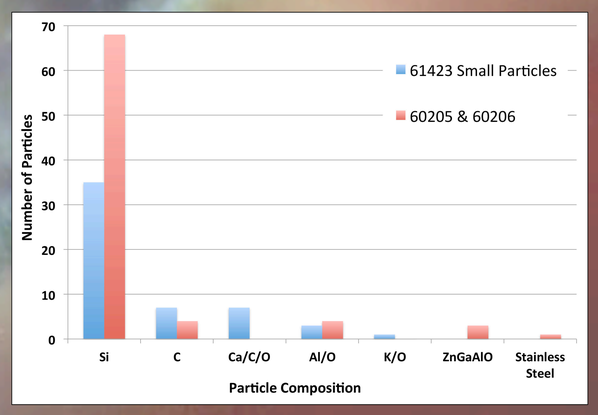
Cellulose Acetate Extraction Replica of Genesis Silicon Sample 61423



SEM image of a cellulose acetate extraction replica of Genesis sample 61423 and corresponding EDS maps for silicon, aluminum, germanium, gallium and calcium.

Small Particle Survey of Cleaned Area of 61423





(Left) SEM image of nominally clean area of silicon sample 61423 for the small particle survey. (Right) Composition of the 53 particles analyzed in the small particle survey of Genesis sample 61423 and the 80 particles on 60205 & 6026 compiled by Allton, et al. (2007) for comparison.

References: [1] Calaway, M. J., et al. (2009) LPSC XL Abstract #1183. [2] Allums, K. K., et al. (2015) LPSC XLVI, Abstract #2014. [3] Kuhlman, K. R., et al. (2014) LPSC XLV, Abstract #2030. [4] Allton, J. H., et al. (2007) LPSC XXVIII, Abstract #2138.