GENESIS CLEANING AND PARTICLE ANALYSIS TECHNIQUES: AN UPDATE. Kimberly R. Kuhlman[1], Ian Lyon[2], and Donald S. Burnett[3], [1]Planetary Science Institute, 1700 East Fort Lowell Blvd., Suite 106, Tucson, AZ 85719, (kim@psi.edu), [2]The University of Manchester, Manchester, M13 9PL, UK (Ian.Lyon@manchester.ac.uk); [3]Division of Geological and Planetary Sciences, 100-23, California Institute of Technology, Pasadena, CA 91125 (burnett@gps.caltech.edu).

Introduction: The hard landing experienced by the Genesis sample return capsule breached the science canister containing the solar wind collector arrays and concentrator target. The impact into the damp lakebed contaminated collector surfaces with pulverized collector and spacecraft materials as well as sediment and brine residue from the lakebed [1]. The gold foil, polished aluminum, and bulk metallic glass remained intact, but most solar wind bulk and regime-specific array collectors were jarred loose from their frames and fractured into more than 10,000 specimens [2]. After a year of investigation and cleaning experimentation, the Genesis Science Team has determined that the array collectors have three classes of particulate contaminants: particles resulting from the hard-landing, submicron inorganic particulates or "aerosol", and prelaunch surface contamination [2]. Currently, megasonically energized ultrapure water (UPW) is being used to remove the particulate debris from array collector fragments. However, particles less than 1 micron in diameter appear to be recalcitrant to this cleaning technique. Some particles are also recalcitrant to removal using ozone treatments) and etching with various acids. Hence our focus has been to characterize the remaining particles and films in order to better tailor cleaning methods.

Characterization of contamination using the in-lens detector on a Zeiss SEM: The Zeiss 1530 SEM at the University of Wisconsin has the unique capability of an in-lens detector to illuminate far more damage and contamination than is possible using the normal secondary detector on an SEM. This capability is demonstrated in the direct comparison of the images shown in Figure 1. The light smudges and streaks appear to be very thin films of material that appear to have been deposited on the samples during the hard landing and are distinguished from the base material because of the in-lens detector's capability of collecting only those secondary and back-scattered electrons emanating from the very surface of the material. Only very slight topography is visible in a normal SEM image, providing one knows where to look.

Cleaning Genesis samples using an HF/HCl solution: Sample 60130 was cleaned with ozone and etched with an HF/HCl solution. It was then analyzed using a TOF-SIMS with a gold ion beam at the University of Manchester and showed hot spots of Na, K and Ca (Figure 2). The first region of interest analyzed by the TOF-SIMS (marked by the arrrow in Figure 1)

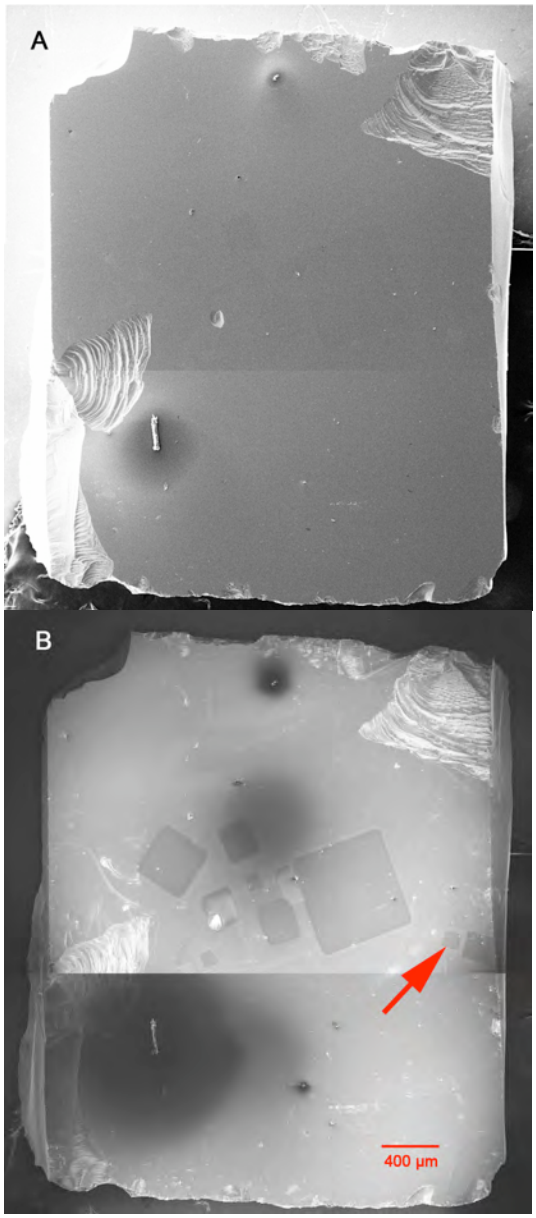

Figure 1. Mosaic images of silicon flight sample 60130 illustrating the dramatic difference in imaging capability between the typical secondary electron detector (SEM) (top) and the in-lens detector featured in the Zeiss SEM and CrossBeam (bottom). The arrow indicates the region of interest analyzed by both TOF-SIMS and SEM/EDX.

was imaged using the in-lens detector in a Zeiss SEM at the University of Wisconsin. The sample was shown to retain high numbers of submicron particles. In several cases the films were so thin they could not be analyzed (Figure 3a). Some particles are rich in O, Fe and Ca. We also saw a bright particle that appears to be glued to the sample by a "puddle" of film. It appears to be Ca-rich from a point EDX spectrum (Figure 3b).

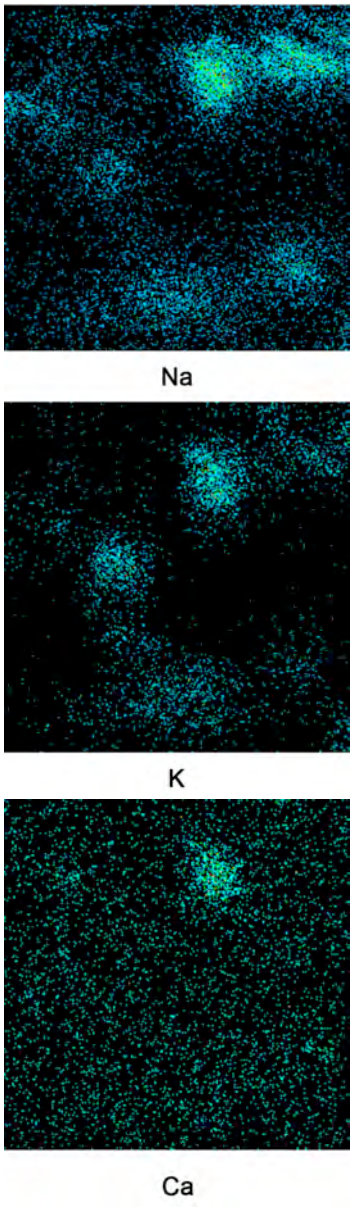

Figure 2. TOF-SIMS maps of Ca, Na and K obtained from sample 60130 using a gold ion beam at Univ. of Manchester. The field of view is approx. 100 µm by 100 µm.

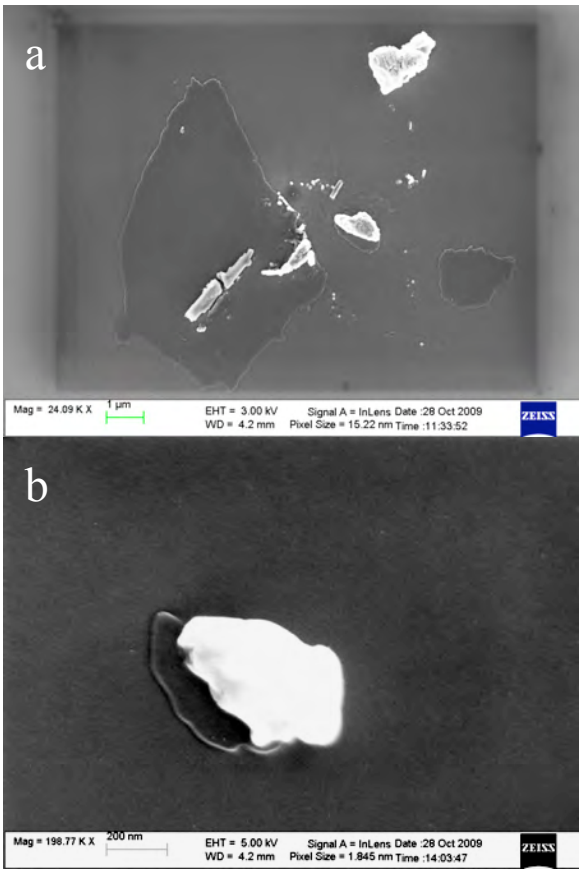

Figure 3. In-lens SEM images of films and particles remaining following ozone cleaning and acid etching and after analysis in the TOF-SIMS.

References: [1] Allton J. H. et al. (2005) LPSC XXXVI, Abstract #2083. [2] Allton J. H. et al. (2005) LPSC XXXVII, Abstract #2324.