

Microbial Monitoring of Astromaterials Curation Labs Reveals Inter-Lab Diversity

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Introduction: The Astromaterials Curation Division at NASA's Johnson Space Center houses seven sample collections stored in separate clean rooms to avoid cross-contamination. Prior to receiving new sample collections from carbon rich asteroids, we instituted a monitoring program to characterize the microbial ecology of these labs and to understand how organisms could interact with and potentially contaminate current and future collections.

Methods: Beginning in Oct. 2017 we sampled the Meteorite (ISO 7 equivalent) and Pristine Lunar (ISO 5 equivalent) labs on a monthly basis. Surface samples were collected using dry swabs. Air samples were collected using an impactor style air sampler. Cultivable organisms were identified and characterized. Aliquots of each sample were also preserved for DNA sequencing. For each sampling event recovery rate was calculated as the percentage of samples showing microbial growth¹. Fungal colonies were selected for amino acid extraction and analysis via Ultra-Performance Liquid Chromatography with Fluorescence Detection and Mass Spectrometry.

Results: During the initial 16 month period we isolated 102 unique organisms. The majority (80) are bacterial while the other 22 are fungal. The meteorite lab has higher diversity with 93 isolated organisms. While the lunar lab only produced 27 organisms. 18 of these organisms were found in both labs while 75 were unique to the meteorite lab and 9 were unique to the

lunar lab. Most of these organisms were isolated from non-sterile floors and walls of the labs (0.17 – 0.38 CFU / 25 cm²). Work surfaces are generally cleaner ≤ 0.08 CFU / 25 cm². As expected the number of CFU's (Colony forming units) collected from air samples does not correlate to the number of CFU's collected from surface samples. The most abundant organisms are human associated bacteria and fungi. Despite the differences in diversity the median recovery rate for the two labs is nearly identical (Figure 1) (Lunar = $0.33 \pm .13$, Meteorite = 0.38 ± 0.09). To date we have not identified any fungi capable of producing amino acids that could be misinterpreted as extraterrestrial.

Conclusions and Future Work: Despite being co-located and having similar recovery rates the two curation labs have distinct microbial populations. This is not surprising considering that the labs are physically isolated from each other to avoid cross-contamination. Each lab has a dedicated air-handling system and a separate cohort of scientists and technicians. We plan to perform amplicon DNA sequencing to further characterize the ecology of these labs and to test several cleaning protocols in an effort to reduce the median recovery rate without compromising the sample collections.

References:

1. The United States Pharmacopeial Convention. **17**, 784–794 (2013).

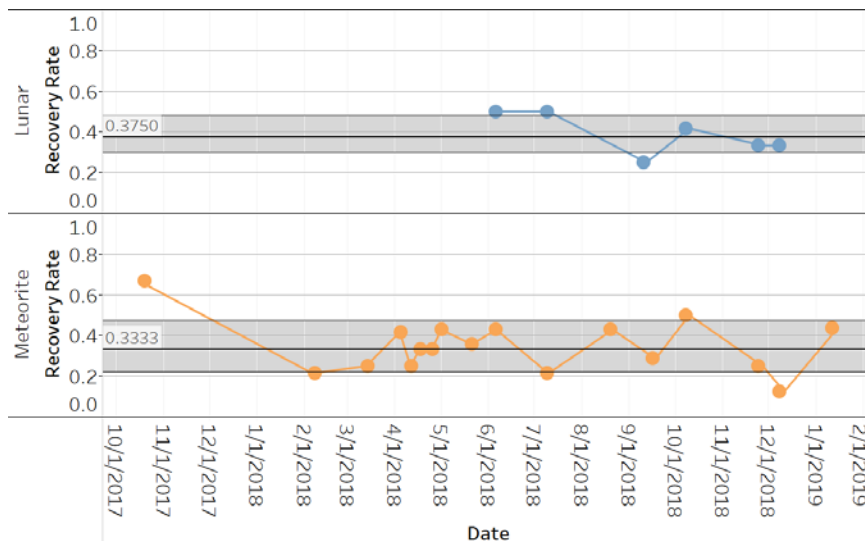


Figure 1: Recovery rate for each sampling event from the curation labs. Solid black line is the median recovery rate. Shaded boxes represent one standard deviation from the mean.