Evolution of the Lunar Receiving Laboratory to the Astromaterial Sample Curation Facility: Technical Tensions between Containment and Cleanliness, between Particulate and Organic Cleanliness

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The Lunar Receiving Laboratory (LRL) was planned and constructed in the 1960s to support the Apollo program in the context of landing on the Moon and safely returning humans [1]. The enduring science return from that effort is a result of careful curation of planetary materials. Technical decisions for the first facility included sample handling environment (vacuum vs inert gas), and instruments for making basic sample assessment, but the most difficult decision, and most visible, was stringent biosafety vs ultra-clean sample handling. Biosafety required handling of samples in negative pressure gloveboxes and rooms for containment and use of sterilizing protocols and animal/plant models for hazard assessment. Ultra-clean sample handling worked best in positive pressure nitrogen environment gloveboxes in positive pressure rooms, using cleanable tools of tightly controlled composition. The requirements for these two objectives were so different, that the solution was to design and build a new facility for specific purpose of preserving the scientific integrity of the samples. The resulting Lunar Curatorial Facility was designed and constructed, from 1972-1979, with advice and oversight by a very active committee comprised of lunar sample scientists. The high precision analyses required for planetary science are enabled by stringent contamination control of trace elements in the materials and protocols of construction (e.g., trace element screening for paint and flooring materials) and the equipment used in sample handling and storage. As other astromaterials, especially small particles and atoms, were added to the collections curated, the technical tension between particulate cleanliness and organic cleanliness was addressed in more detail. Techniques for minimizing particulate contamination in sample handling environments use high efficiency air filtering techniques typically requiring organic sealants which offgas. Protocols for reducing adventitious carbon on sample handling surfaces often generate particles. Further work is needed to achieve both minimal particulate and adventitious carbon contamination [2]. This paper will discuss these facility topics and others in the historical context of nearly 50 years' curation experience for lunar rocks and regolith, meteorites, cosmic dust, comet particles, solar wind atoms, and asteroid particles at Johnson Space Center.

References: [1] Allton J. H. et. al.(1998) Adv. Space Res.v.22, no. 3,373-382. [2] Calaway M. J. et al. (2014) NASA/TP-2014-217393.

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