LARGE AREA IMAGING OF PLANETARY MATERIALS.

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Introduction: Astromaterials such as meteorites and Lunar samples are extremely limited necessitating advanced non-destructive analytical techniques to maximize data collection. Petrographic thin sections of these materials are precious and as much information should be extracted as possible prior to using destructive techniques. High resolution imaging of entire samples is often precluded by cost and large image mosaics are limited by computer processing power. Here we use Large Area Imaging, a scanning electron microscope (SEM) -based imaging technique developed by Fibics Inc., to maximize data acquisition in two distinct scientific contexts: 1) image acquisition of Lunar samples for future investigations and shared resource curation, and 2) investigating biogeochemical processes that occur on multiple scales to aid in the interpretation of biosignatures.

Large area imaging: Large Area Imaging (LAI) systems such as the Carl Zeiss "Atlas" module allow for contiguous image acquisition at resolutions as high as 100 nm (pixel size) for areas approaching 25 cm^2, using backscattered and secondary electrons in both traditional high vacuum and variable pressure SEM modes. LAI will allow us to investigate large areas of up to tens of millimeters in scale and expand anywhere within these areas to see details on the micrometer to nanometer scale while retaining full contextual information regarding the areas under investigation. Full images are stored on remote servers precluding the need for specialized computing resources. Using this primary information, additional micrometer-scale data sets such as EDX spectroscopy, millimeter-scale datasets such as transmitted light photomicrographs, and nanometer-scale information such as synchrotron-based spectroscopy, can be registered and fused with the LAI SEM images. LAI and data fusion facilitates critical connections across spatial scales to test hypotheses that cross the threshold of traditional microscopy methods.

Lunar thin section imaging: Large area imaging of select petrographic thin sections prepared from Apollo samples will allow for the curation of hundreds of gigabytes of image data for future study and collaborative work without requiring sample transport. By imaging the entire thin section to nanometer-scale resolution will provide multiple research teams with access to preliminary data to plan future analyses and provide scalar context for subsequent work.

Biosignature interpretation: Biogeochemical processes operate on multiple scales and evidence of these phenomena can be difficult to observe across scales. For example, microbial etching of glass occurs on a nanometer scale. However, interpreting a pattern of glass etching as abiotic or biogenic depends on observations at the micrometer to centimeter scale to assess evidence for microbial populations and/or biological behavior. Using multiple phases of LAI before, during, and after microbial culturing will allow for substrate comparisons at the millimeter to micrometer scale.

Conclusions: Large area imaging represents a unique tool to acquire unprecedented image data quickly in a non-destructive manner. The use of LAI allows for the curation of large image datasets for multiple teams to access precluding the need to transport precious samples.