ASSESSING AN ASTEROID SAMPLE RETURN COLLECTION MECHANISM.

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Introduction: Samples returned from planetary bodies are valuable and unique scientific resources, enabling numerous studies and resulting insights about our solar system that are not possible from remote observations alone. Already, two Discovery class missions have been focused sample return missions, returning samples of the solar wind and a comet; an asteroid sample return mission has a strong scientific motivation and is a likely mission for selection by the NASA Discovery or New Frontiers Programs in the near future.

The Applied Physics Labortatory (APL) has been developing a sample acquisition system to be used to collect samples from the regolith of an asteroid [1]. The sampling implementation approach involves simultaneous sampling of the regolith through a touch-and-go mission design; both surface samples and subsurface samples will be acquired during the short, 1 to 2 second, touch-down on the surface.

In this system, the sampling technique used for the surface sampler is a “sticky pad”. This simple and robust sampling technique has been demonstrated to successfully collect loose particles from a surface with a sticky material on the sampler [1]. The sticky materials being investigated at APL include a variety of high vacuum greases designed for a range of temperatures. Another critical step in assessing the success of the "sticky pads" is to investigate the ability of these samplers to not compromise the scientific integrity of the samples by their collection method, and that is the focus of the work we present here.

Approach: Fundamental to our approach is the use of primitive meteorites, which are samples from asteroids and therefore directly relevant. A primitive meteorite type is also a good choice because it has many different minerals and components; selecting a material with a complex mineralogy will provide a more robust test of the ability to preserve a range of components. The National Museum of Natural History of the Smithsonian Institution has provided us with samples from two meteorites: Allende (CV chondrite meteorite) and Allegan (H chondrite meteorite). Since both of these samples were observed falls, these meteorites have had a limited time on Earth's surface and are consequently unweathered, which also makes them ideal samples for our assessment tests.

Using the same materials as the larger prototype "sticky pads," we created "mini sticky pads" for sampling the two meteorite types. Two sticky materials were chosen for initial investigations. Figure 1 shows our "mini sticky pads" during various stages of preparation. The meteorite samples were powders, and each of the two meteorite types was sampled with each of the two sticky materials.

These prepared "mini sticky pads" will now serve as our returned sample, and we will apply the same analytical techniques to these samples as would be used following an asteroid sample return mission. We have just obtained preliminary measurements on the reflectance spectra of these samplers and are analyzing the data. We will also measure the bulk chemistry and mineralogy and compare the results to measurements made prior to sampling. This work will allow us to assess the ability of the "sticky pad" sampling approach to preserve the scientific integrity of the collected sample for an asteroid sample return mission.

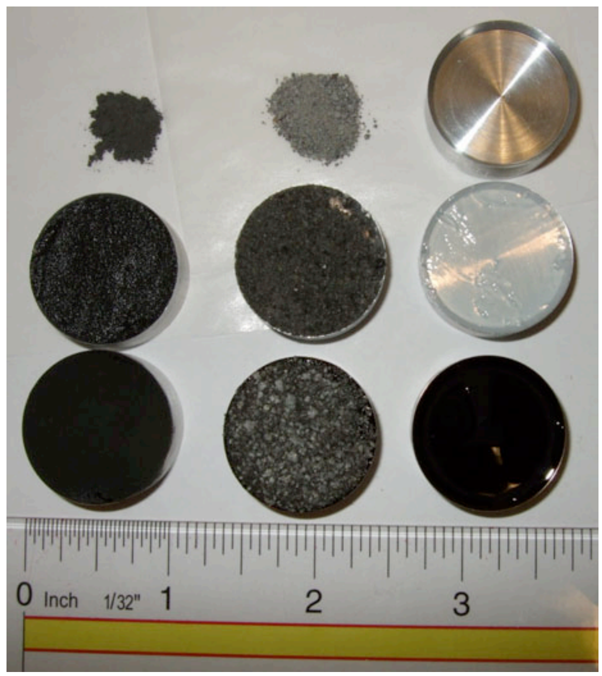

Figure 1. Our "mini sticky pads" are shown in various stages of preparation. ***Top row:*** the unsampled meteorite powders of Allende (left) and Allegan (middle) and a clean aluminum "mini sticky pad" (right). ***Middle row:*** Allende (left) and Allegan (middle) sampled by the vacuum grease on the middle right. ***Bottom row:*** Allende (left) and Allegan (middle) sampled by the vacuum grease on the bottom right.

References: [1] Lees J. et al. (2006) *Inter. Astro. Conf.*, IAC-06-A3.5.04.