THE STRATA-1 EXPERIMENT ON MICROGRAVITY REGOLITH SEGREGATION.

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Description: The Strata-1 experiment studies the segregation of small-body regolith through long-duration exposure of simulant materials to the microgravity environment on the International Space Station (ISS). Many asteroids feature low bulk densities, which implies high values of porosity and a mechanical structure composed of loosely bound particles, (i.e. the "rubble pile" model), a prime example of a granular medium. Even the higher-density, mechanically coherent asteroids feature a significant surface layer of loose regolith. These bodies will evolve in response to very small perturbations such as micrometeoroid impacts, planetary flybys, and the YORP effect. A detailed understanding of asteroid mechanical evolution is needed in order to predict the surface characteristics of as-of-yet unvisited bodies, to understand the larger context of samples from sample return missions, and to mitigate risks for both manned and unmanned missions to asteroidal bodies. Due to observation of rocky regions on asteorids such as Eros and Itokawa, it has been hypothesized that grain size distribution with depth on an asteroid may be inhomogeneous: specifically, that large boulders have been mobilized to the surface. In terrestrial environments, this size-dependent sorting to the surface of the sample is called the Brazil Nut Effect. The microgravity and acceleration environment on the ISS is similar that of a small asteroid. Thus, Strata-1 investigates size segregation of regolith in an environment analogous to that of small bodies.

Strata-1 consists of four regolith simulants in evacuated tubes, as shown in Figure 1 (Top and Middle). The simulants are (1) a crushed and sieved ordinary chondrite meteorite to simulate an asteroidal surface, (2) a carbonaceous chondrite simulant with a mixture of fine and course particles, and two simplified silicate glass simulants; (3) one with angular and (4) another with spherical particles. These materials were chosen to span a range of granular complexity. The materials were sorted into three size species pre-launch, and maintained during launch and return by a device called the Entrapulator. The hypothesis under test is that the particles that constitute a granular medium in a micro-gravity environment, subjected to a known vibration environemnt, will segregate in accordance to modeled predictions.

Strata-1 is currently operating on ISS, with cameras capturing images of simulant motion throughout the one year mission. Vibration data is recorded and downlinked, and the simulants will be analyzed after return to Earth.

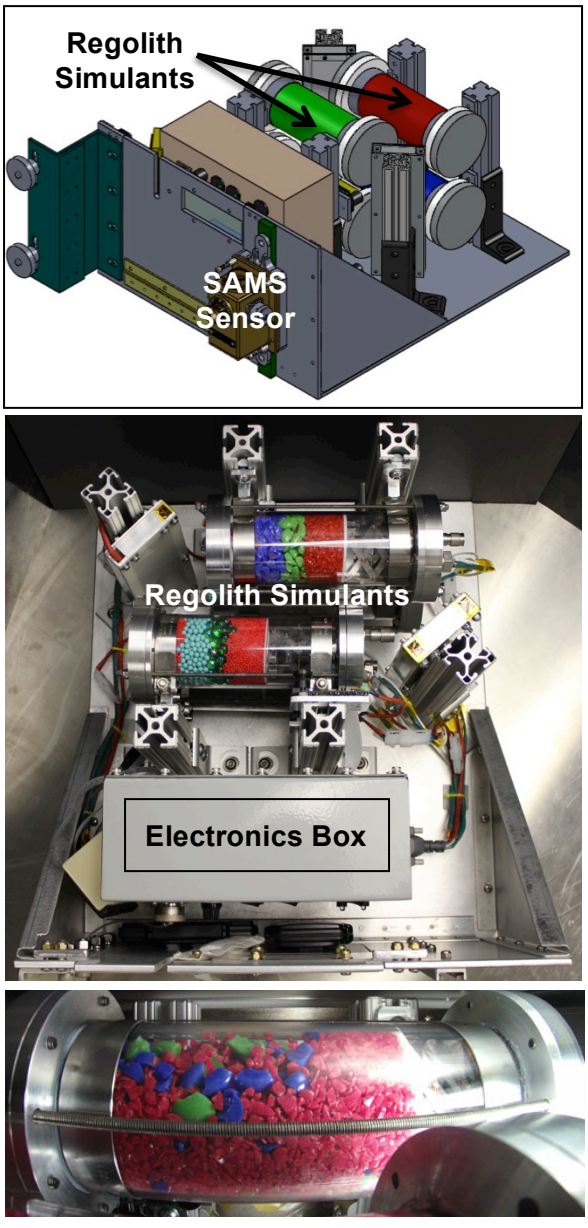

Figure 1:Top: CAD model of Strata-1 with the SAMS acceleration package attached to the front plate. Note the four tubes carrying asteroid regolith simulants. There is a camera for each tube (not shown). Middle: Top-down image of the assembled Strata-1 experiment. Bottom: Strata-1 image of one of the regolith simulants moving freely in microgravity aboard ISS.