SAMPLE RETURN FROM DEIMOS: THE GULLIVER MISSION. D. T. Britt[1] and the Gulliver Team, [1] University of Central Florida (Department of Physics, Orlando, FL 32816, britt@physics.ucf.edu).

Introduction: Deimos presents a unique opportunity for a sample return mission. It is spectrally analogous to type D asteroids, which are thought to be composed of highly primitive carbonaceous material that originated in the outer asteroid belt. It also is in orbit around Mars. As such it has been accumulating material ejected from the Martian surface ever since the earliest periods of Martian history, over 4.4 Gyrs ago [1]. Deimos's position in the Martian gravity well makes it more likely to accumulate and retain material since much of the ejecta from Deimos will not have the velocity to escape the Martian system. Trapped in the Martian gravity well, most material will eventually reaccrete to Deimos [2]. Deimos is also probably a low-density rubble-pile and that structure strongly dissipates impact energy, further limiting ejection velocities and material escape [3]. Because of stochastic processes of regolith mixing over 4.4 Gyrs, the rock fragments, grains, and pebble-sized materials will likely sample the diversity of the Martian ancient surface and as well as thoroughly mixing the original primitive material of Deimos. Analysis of Martian ejecta, material accumulation, capture cross-section, regolith overturn, and Deimos's albedo suggest that Mars material may make up as much as 10% of Deimos's regolith. The Martian material on Deimos would be dominated by ejecta from the ancient crust of Mars, delivered during the Noachian Period of basin-forming impacts and heavy bombardment. .

Mission: The Gulliver Mission proposes to directly collect up to 2 kilograms of Deimos regolith and return it to Earth. The spacecraft instrument suite is tightly focused to the requirements of finding a safe and scientifically interesting sampling location, collecting a sample, and returning to Earth safely. They include a high-resolution imaging camera for navigation and sampling site selection, a radar altimeter for closed-loop approach maneuvering, and a wide-angle descent imager to record the sampling site and the actual sampling process. Deimos is also by far the safest small body for sample return yet imaged. The inherent robustness of Earth-based cosmochemical laboratory analysis, along with the diversity of the sample, allows the mission scientific goals to be both ambitious and comprehensive: (1) Determine the geochemistry of the accretion zones for the primitive D-type asteroids found in the outer asteroid belt and near Jupiter. (2) Study pre-biotic materials in primitive asteroids for their implications on the chemistry and astrobiology of outer solar system objects. (3) Search for isotopic biomarkers in the early crust of Mars. (4) Determine the composition, diversity, and crystallization history of the Martian crust. (5) Date and characterize the era of Martian heavy bombardment. After initial processing these samples will be made available as soon as possible to the international cosmochemistry community for detailed analysis. The mission management team includes Lockheed Martin Astronautics (flight system, I&T) and JPL (payload, mission ops, and mission management).

References: [1] Burns J. A. (1992) Mars (Kieffer H. H. et al., eds), 1283-1302. [2] Hamilton D. P. (1996) Icarus 119, 153-172. [3] Housen, K.R. et al.. (1999) Nature, 402, 155-157.