**ASTEROID SAMPLE RETURN: 433 EROS AS AN EXAMPLE OF SAMPLE SITE SELECTION.** Daniel. T. Britt[1], Derek W. G. Sears[2], and Andrew F. Cheng[3]. [1]Dept. of Geological Sciences, Univ. of Tennessee, Knoxville, TN 37996, dbritt@utk.edu. [2]Arkansas-Oklahoma Center for Space and Planetary Science, Univ. of Arkansas, Fayetteville, AR 72701, cosmo@uafsysb.uark.edu. [3]Applied Physics Laboratory, Johns Hopkins Univ., Laurel, MD 20723, andrew.cheng@jhuapl.edu.

**Introduction:** The success of the NEAR-Shoemaker mission to 433 Eros highlights a possible next step in asteroid and meteorite science, a sample return from an asteroid. Sample return is necessary because of the range of science that can be done with the unparalleled precision, variety, and accuracy . The data would provide critical "ground-truth" geochemistry for remote sensing observations, determination of the age of the asteroid and its surface, analysis of trace isotope ratios to determine early nebular processing, analysis of its petrography and mineralogy to determine geochemical evolution and processes, to name a few. These scientifically critical measurements typically cannot be done remotely or *in-situ* to the level of precision required. A number of sample return missions are on the horizon, such as the Japanese Space Agency's MUSES-C mission and the proposed HERA mission.

The common theme of any asteroid sample return mission will be to use remote sensing instruments to identify sampling sites that characterize the variety of materials on the surface and the scientifically significant sites. Sampling sites should include: (1) Sites that are representative of the major geochemical units identified on the asteroid. (2) Sites that are representative of the major morphological units. (3) Sites that sample the regolith processes of the asteroid including variations from fresh to weathered material. We can use the extensive NEAR database as a practical example of how potential sampling sites can be identified, ranked, and selected.

**NEAR at Eros:** Highlights of the NEAR mission include the detailed optical and laser mapping, determination of the major-element geochemistry, bulk density, and spectral maps. NEAR also confirmed our ability to maneuver spacecraft in a low-g environment and even soft land. The mineralogy of Eros was found to be spatially uniform and similar to L chondrites. Significant morphologies included the "ponds", areas of deposition of fine-grained materials near the bottom of craters in the equatorial region, the variation of light and dark materials in some exposed crater walls, the large boulder population, and the ubiquitous deposition of regolith.

**Sampling Sites:**

**(1) Average Eros**: A high priority is representative samples of the major geochemical units on Eros. A sample from an "average" site would provide insight on major questions of asteroid science and calibrate the remote sensing observations already made.

**(2) Ponds:** The so-called "ponds" of Eros, shown in spectacular close-up by the spacecraft during landing, are the most puzzling and unexpected features on the body. They appear to be limited to the equatorial regions of Eros and may be associated with the reaccretion of fine-grained ejecta. Whatever they are, they represent a significant discovery that possibly can be generalized to other asteroids. In all probability, meteorites made of such material would never survive passage to Earth.

**(3) Bedrock and Boulders:** Both the average Eros and the ponds are probably composed of regolith material that has been crushed, shocked, and possibly altered by surface processes. To obtain unaltered material the best source would be either exposed bedrock or some of the numerous large boulders common on the surface.

**(4) Crater Transect: Floor, Wall, Ejecta:** Impacts are perhaps the major process on asteroids. A crater transect would sample highly altered material from the crater bottom, material from the walls that show albedo variations, and fresh ejecta from the periphery of the crater.

The samples would capture the mineralogical and geochemical variety on Eros and provide fundamental ground truth for remote observations, asteroid science. and meteoritics