

Gathering Asteroid Dust, Guided by OSIRIS-REx Images

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The OSIRIS-REx asteroid sample return mission is the third mission in NASA's New Frontiers Program and will be the first U.S. mission to return samples from an asteroid to Earth. In December of 2018, the mission rendezvoused with asteroid (101955) Bennu, a hydrated and carbon-rich "rubble pile" whose composition may be analogous to that of the objects that delivered water and volatiles to early Earth. Upon arrival, the OSIRIS-REx Camera Suite (OCAMS) revealed the surface of Bennu to be significantly more rugged and rocky than expected. The rough surface, combined with an apparent scarcity of fine-particulate material ingestible by the spacecraft's sampling mechanism (particles ≤ 2 cm in diameter), complicated the process of identifying a safe and sampleable site.

Despite these complications, the OSIRIS-REx mission embarked on a year-long sample site selection effort using visible-wavelength images to guide the process. A global imaging campaign allowed the team to identify the most promising candidate sample sites, and subsequent regional imaging campaigns enabled quantitative comparisons between these candidate sites. The OSIRIS-REx team also used global and regional images to construct digital terrain models (resolved down to 80 cm globally) and high-resolution maps (resolved down to 5 cm globally) of the asteroid surface; these products were vital for identifying and measuring potential hazards to the spacecraft, such as boulders. In December 2019, the team selected primary and backup sites for sample collection. OCAMS then acquired images with pixel scales of just millimeters at each location to confirm the presence of sampleable particles. On October 20, 2020, the OSIRIS-REx spacecraft successfully sampled the surface of asteroid Bennu at the primary site, gathering more than its requirement of 60 grams of dust and pebbles and underscoring the value of the mission's imaging strategy.