OSIRIS-REx and mission sample science: The return of at least 60 g of pristine regolith from asteroid Bennu

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Introduction: The Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer (OSIRIS-REx) asteroid sample return mission was selected by NASA in May 2011 as the third New Frontiers mission. The target, (101955) Bennu, is a B-type near-Earth asteroid (NEA), hypothesized to be similar to CI or CM carbonaceous chondrites. The key science objectives of the mission are summarized in [1]. To meet these science objectives, the science team is coordinated and governed by the Science Executive Council (SEC): A group of six persons that run various elements of mission science. Mission Sample Science (MSS) is charged with analysis of the returned sample.

Mission Sample Science: MSS is run by a Mission Scientist and composed of the following working groups: Carbonaceous Meteorite Working Group (CMWG), Dynamical Evolution Working Group (DEWG), Regolith Development Working Group (RDWG), Sample Analysis Working Group (SampleWG), Sample Site Science Working Group (SSSWG), and TAGSAM Working Group (TAGSAMWG). CMWG works to define and create well-characterized test samples, both natural and synthetic, for the development of spectral test data. These data are used to verify the depth and accuracy of spectral analysis techniques for processing data collected by the OSIRIS-REx spectrometers (OVIRS and OTES). The DEWG is charged with constraining the history of asteroid Bennu from main-belt asteroid to NEA. They also work closely with the SampleWG to define the hypotheses for the dynamical evolution of Bennu through the analysis of the returned sample. The RDWG is focused on developing constraints on the origin and evolution of regolith on Bennu through investigations of the surface geology and, working with the SampleWG, test these hypotheses through sample analysis. RDWG is also focused on the analysis of the sampling event and reconstructing what occurred during the event. SampleWG is focused on documenting Contamination Knowledge, which is distinct but related to mission Contamination Control. The main deliverable for this working group is the Sample Analysis Plan, due in 2019. Furthermore, it is this working group that is responsible for constituting the Preliminary Examination Team (PET) and performing the analyses of the returned sample during the first six months after return. SSSWG has the main deliverable of providing to the project the Science Value Maps (SVMs), which are part of the sample site selection process. If we can deliver the spacecraft to candidate sample sites, if it is safe to sample at them, and if there is material that can be ingested, SVMs will be a semi-quantitative aid in picking the optimum site to meet mission science goals. Finally, TAGSAM (Touch And Go Sample Acquisition Mechanism) is the sampler for the mission and this working group is concerned primarily with characterizing TAGSAM capabilities against a range of regolith types. Mission Sample Science provides an over-arching structure to reconstruct the pre- and post-accretion history of Bennu from the formation of pre-solar grains, chondrules, up to geological activity within the asteroid to its final dynamical evolution through analysis of the returned sample using a wide range of disciplines and expertise.

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References: [1] Lauretta D. S. and The OSIRIS-REx Science Team, 2012. 43rd LPSC, Abstract 2491.