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A search for near-infrared spectral signatures of bright boulders on OSIRIS-REx target asteroid (101955) Bennu

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1. Introduction

Origins, Spectral Interpretation, Resource Identification, and Security–Regolith Explorer (OSIRIS-REx) is NASA's New Frontiers asteroid sample return mission. The OSIRIS-REx spacecraft is equipped with a suite of scientific instruments to characterize the surface of the target asteroid, (101955) Bennu [1], including the OSIRIS-REx Camera Suite (OCAMS) and the OSIRIS-REx Visible and InfraRed Spectrometer (OVIRS). OCAMS's high-spatial-resolution images of Bennu's surface facilitate the identification of regions of interest, characterization of surface morphology, and mapping of relative surface albedo [2]. OVIRS is a point spectrometer that measures surface composition [3]. The OVIRS footprint during the Detailed Survey phase of the mission has an observational field of view (FOV) diameter between 14 and 20 m.

We compare the OVIRS data (**high spectral resolution**) with an OCAMS global mosaic (**high spatial resolution**) and find spatially consistent variations in albedo [4, 5]. The lower-albedo (~4%), regions of interest span areas that are larger than the OVIRS spectrometer. Kaplan et al. [5] show the spectral trends in OVIRS spectral data of dark areas, and DellaGiustina et al. [6] show spectro-photometry trends of these dark regions with the color imaging data from the OCAMS instrument. However, there are many high-albedo features (~12–15%) that are much less spatially expansive than the dark regions, with size scales on the order of a few centimeters to 5 m—all of which are smaller than the OVIRS field of view. In this study, we complete a census of the bright boulder regions, probing spectral variations. Our hypothesis is that the high-albedo boulders are spectrally different than the global spectrum.

2. Data collection and preparation

2.1 Global Mapping

The OCAMS images were photometrically corrected to standard viewing geometry (incidence = 30°, emission = 0°, phase = 30°). Likewise, the OVIRS data from two days of observation during the Detailed Survey were photometrically corrected to the same geometry. To compare with OVIRS, both data sets were mapped onto the facetized Bennu shape model. The overlapping OVIRS spots larger than the facet size were averaged by weighting according to fractional coverage of the facet. The OCAMS pixels within a facet were averaged, and the resultant value was assigned to the facet.

2.2 Census of Bright Boulders

The positions of the rocks with highest albedo were recorded during a global boulder mapping campaign [7], and we searched for OVIRS spectra that correspond to those areas. Conversely, we also searched for the highest albedo among the OVIRS spectra and then checked the OCAMS imaging data to see whether bright rocks are present within the region.

2.3 Example

In **Figure 1** we show an example of the type of circumstances we are including in this search. Two OVIRS spots taken side by side are shown, one with a brighter boulder and the other with no large visible bright boulders. Because the spectral features on Bennu are very subtle in color, we take a ratio of the two spectra. This process reveals whatever is distinct between the two regions. When we do this for hundreds of boulders, we can build up a statistical understanding of our sub-spectrometer-FOV sensitivity to the brighter rocks on Bennu.

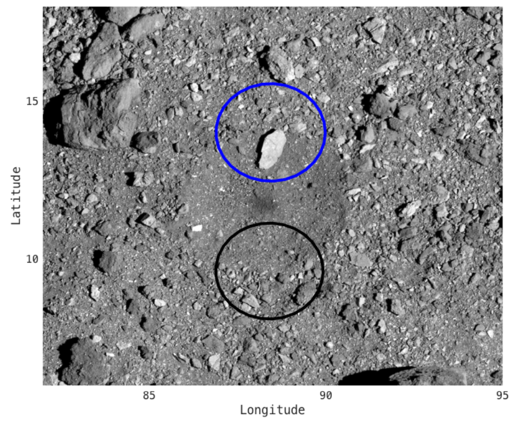

Figure 1. An OCAMS image with two OVIRS footprints overlain from Baseball Diamond Flyby 3. The brighter boulder in the blue footprint is 5.7 m in length, and it covers roughly 10% of the OVIRS footprint area.

3. Summary and future work

Our ongoing survey of the bright rocks is yielding interesting early results. While most brighter rocks on Bennu are smaller than the footprint size of the spectrometer's FOV, by comparing and calculating the ratios with nearby spots, we can mathematically determine the bright boulder contribution to the overall spectral behavior of the OVIRS data.

Ongoing work is to sift out the bright rock signal from all of the OVIRS spectra. For this presentation, we will present a complete census of the bright rock spectra and discuss possible compositional implications. We will present our results analyzing individual regions of interest (on a spot-by-spot basis) and global patterns in bright rock color. Our results will be compared with those of DellaGiustina et al. [6] and Kaplan et al. [5].

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