COMPARING OVIRS SPECTRA OF THE BRIGHT BOULDERS ON BENNU WITH ASTEROID SPECTRA.
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Introduction: Although the overall geometric albedo of Bennu is very low (0.044 ± 0.002) [1] there are a few very bright boulders first discovered in the MapCam images [1]. These meter-scale boulders have geometric albedos greater than 0.14, and also have distinctive spectral signatures [2,3]. DellaGiustina et al. [2] have analyzed these spectra by comparing them to likely meteorite analog materials. We extend this analysis to asteroid spectra, primarily near-Earth asteroids (NEAs) to bridge the size range from meteorite scale (~cm) to the possibly more heterogeneous compositions that are represented by the NEA population. DellaGiustina et al. [2] note that the bright boulder albedos and spectra are so unlike the rest of Bennu that they are likely to be exogenous material, either inherited from Bennu's parent asteroid, or from collisions at the time of formation or later. In this presentation, we will explore the range of NEAs that might be consistent with such collisions, to constrain the possible origin and history of the exogenous material on Bennu.

S-complex and V-type asteroids: The pyroxene-like spectra seen by the OVIRS instrument are similar to several taxonomic groups of NEAs. The spectral range of the OVIRS instrument (0.4-4 microns) includes the diagnostic visible and near-infrared region for which we have a large database of asteroid observations. The MITHNEOs program [4], among others, has provided a large public archive of spectra which may be more representative of the material impacting the Earth than the meteorite collection. Some asteroidal materials may be too fragile to survive transport through the Earth's atmosphere.

Figure 1 shows two of the spectra of bright boulders on Bennu along with some comparison asteroid spectra. The spectrum of 4 Vesta, parent of the Vesta family and the NEA family member 2003 YT1 are also shown. The smaller V-type NEAs have deeper bands than 4 Vesta, perhaps due to having fresher surfaces. The S-complex groups Sq and Q-types also have prominent pyroxene features in their near-infrared spectra. NEAs 1685 Toro (Sq) and 2001 SG276 (Q) (whose spectra look more similar to OC meteorites than HED meteorites) are shown for comparison. These spectra have been normalized to 1.0 at 0.8 microns and scaled in band depth to more easily compare them.

Although the spectra of S-complex asteroids bear many similarities to spectra of ordinary chondrite meteorites, there are also differences in continuum slope and band depth that have been the source of much debate (e.g. [5] and references therein). Space weathering effects have been suggested to explain many of these differences, but laboratory simulations have not always shown consistent spectral trends.

The size of the bright boulders (~1-4m) is smaller than most of the NEAs for which we have measured spectra (~0.1-1km). But they are also much larger than most of the carbonaceous chondrite meteorite samples (~1-10cm). Thus, the boulder spectra are likely to be an average of a variety of distinct clasts, similar to hemispherically averaged NEA spectra.

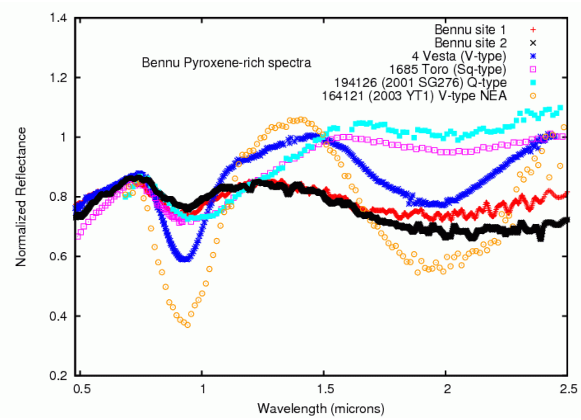

Figure 1. Spectra of asteroid 4 Vesta and some pyroxene-rich NEA taxonomic groups are shown together with two example spectra of the bright boulders on Bennu.

The OVIRS footprint during the Detailed Survey: Equatorial Stations phase was about 20m, so the region surrounding the boulders was also included. The spectra are distinctive enough that the pyroxene bands are clearly seen after dividing by the global average spectrum, which is featureless in the 1–2.5 micron region. We will compare the normalized spectra of the pyroxene material with various asteroid taxonomic groups to look for the best matches using a chi-squared test over the appropriate spectral range.

The bright materials have only been found in a few locations in the global spectral data of Bennu, but our sensitivity is limited by the large spatial scale of the spectra (~20 meters per spectrum). During the Reconnaissance phases of the mission we expect to get spectra with higher spatial resolution (~4 meters per spectrum), so we may be more sensitive to bright materials at smaller size ranges, if they are present at the candidate sample sites. We will use these data to further explore the nature and distribution of this exogenous material.

Acknowledgments: We are grateful to the entire OSIRIS-REx team for making the collection and processing of the data possible, in particular the SAWG and OVIRS instrument team. This material is based upon work supported by NASA under Contract NNM10AA11C issued through the New Frontiers Program.

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