SPECTRAL CHARACTERISTICS OF (101955) BENNU FROM OSIRIS-REx OBSERVATIONS.

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Introduction: Visible to near infrared (VNIR) and thermal infrared (TIR) spectral data collected by the Origins, Spectral Interpretation, Resource Identification, Security–Regolith Explorer (OSIRIS-REx) mission have revealed evidence of widespread, hydrated materials across the surface of asteroid (101955) Bennu [1]. Here we describe spectral features identified in data collected through the Detailed Survey phase of the mission.

OSIRIS-REx Spectrometers: The OSIRIS-REx Visible and InfraRed Spectrometer (OVIRS) is a point spectrometer covering the range from 0.4 to 4.3 μm with a 4-mrad field of view (FOV) and a spectral sampling of 2 nm from 0.392 to 2.4 μm, and 5 nm from 2.4 to 4.3 μm [2, 3]. The OSIRIS-REx Thermal Emission Spectrometer (OTES) is a point spectrometer that measures from ~100 to 1650 cm^{-1} (~5.5 to 100 μm), with an 8-mrad FOV and a spectral sampling of 8.66 cm^{-1} [4]. The OVIRS FOV is within that of OTES but the two boresights are not precisely co-aligned.

OVIRS Results: OVIRS disk-integrated Approach data revealed a VNIR spectrum that is consistent with the ground-based data of [5], having a blue (negative) slope and no visible features above the level of the noise. Because space weathering can cause both blueing and reddening of the spectral slope [e.g., 6], we have not arrived at any definitive conclusions about this process at Bennu. There is no apparent rotational variation in the OVIRS whole-disk spectra. A 0.55-μm feature observed in OCAMS data [7] is not present in the OVIRS data acquired to-date [1, 8]. At longer wavelengths, an unambiguous "3-μm" band is present, consistent with the presence of hydrated silicates, including those contained in low petrologic type CI and CM chondrites. The specific position of this band in OVIRS spectra is 2.74 ± 0.01 μm, most consistent with the positions observed in low petrologic subtype CM2 meteorites [9]. To date, no additional features have been identified with confidence in post-Approach data, but small variations in albedo and spectral slope are apparent; we cannot say if these differences arise from composition, particle size, space weathering, or some combination of these. The optimal equatorial mapping station for OVIRS observations (in terms of signal-to-noise ratio and spatial coverage) is planned to occur on 16 May 2019 and will be used to confirm results to date and look for additional spectral features.

OTES Results: Spatially resolved spectra at ~80 m/spot that were acquired during one of the Preliminary Survey equatorial passes revealed a spectrum with low contrast (~2%) and a spectral shape that is broadly consistent with carbonaceous chondrites in the CI/CM groups and does not vary with rotation [1]. The silicate bending feature in the spectra has a minimum at 440 cm^{-1} (~22.7 μm) and is indicative of a volumetrically dominant phyllosilicate component (i.e., >55%) based on comparison to laboratory meteorite spectra of analogue CM carbonaceous chondrites [1, 10, 11] and laboratory measurements of the meteorites' modal mineralogy [12]. Features at 555 and 346 cm^{-1} in the OTES spectra are attributable to magnetite [1]. At the improved spatial resolutions (~40 m/spot) of more recent Detailed Survey measurements, there is spectral variability, primarily in the shape of the silicate stretching feature and the depth of the silicate bending feature. We also observe variability in the emissivity at low wavenumbers (>1100 cm^{-1}; <8 μm) that may indicate previously unresolved spatial variations in the dominant particle size on the surface. The optimal equatorial mapping station for OTES observations is planned to occur on 9 May 2019.

Summary: The surface of Bennu not only exhibits evidence of hydrated silicates but appears to be dominated volumetrically by such minerals and is consistent spectrally with CI and CM carbonaceous chondrites. Analysis of Bennu's surface geological characteristics indicates that it is a rubble pile that has experienced recent geological processes despite also retaining much older surface features [13]. Small-scale (centimeter to meter) variability in albedo and geologic features suggest that multiple lithologies are present [14], and we will continue to search for spectral signatures of differing compositions in our equatorial mapping data.

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