IS BENNU A CR CHONDRITE? GRO 95577 (CR1) AS A SPECTRAL/MINERALOGICAL ANALOGUE

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Introduction: Orbital spectra of asteroid (101955) Bennu collected by NASA's Origins, Spectral Interpretation, Resource Identification, Security–Regolith Explorer (OSIRIS–REx) spacecraft have identified ungrouped C, CI, and CM meteorites having petrologic types 1, 1/2, and 2 as the best mineralogical analogues to Bennu to date [e.g., 1-3]. CR chondrites generally have not been considered as analogues for the bulk composition of Bennu, primarily because the vast majority are petrologic type 2 and contain ~20-55 vol% anhydrous silicate [e.g., 4]. We present spectral evidence that Grosvenor Mountains (GRO) 95577, the only currently known CR1, is the best spectral analogue yet for Bennu [4], and its mineralogy [5] is consistent with prior estimates of Bennu's bulk surface mineralogy [3].

Spectral Data: OSIRIS–REx carries visible to near infrared (VNIR, OVIRS) and thermal infrared (TIR, OTES) spectrometers for measurement of mineralogy and organics [6]; here we compare Bennu spectra to laboratory data in both wavelength ranges.

VNIR data. At wavelengths <2.5 µm, spectra of Bennu are known to be affected by space weathering [e.g., 7] and laboratory spectra of GRO 95577 are affected by terrestrial weathering [e.g., 8], complicating the comparison of these datasets. However, both share a narrow, sharp hydration band centered at 2.74 µm and a complex of features from 3.2 - 3.6 µm indicative of the presence of organics and carbonates (not shown).

TIR data. The GRO 95577 spectrum exhibits strong similarities with Bennu spectra [3, 9], providing a better spectral match to virtually all spectral minima and maxima than any other C-ung, CI, or CM meteorite examined (Fig. 1). A particularly diagnostic pair of features are the Mg-OH plus magnetite (mt) absorption and the peak at ~528 cm^{-1} that are not well matched by CM chondrites.

Implications: Isotopic, elemental, and petrologic analyses of the sample to be returned from Bennu will be needed to determine with certainty to which meteorite group(s), if any, Bennu belongs. Until such an assignment is made, we can speculate on some of the implications of Bennu as a CR1. CR-like parent bodies are targets of interest because they contain some of the most pristine materials from the solar nebula and can contain substantial amounts of H_2O and OH^- in addition to exotic organics. Terrestrial weathering makes constraining their indigenous mineralogy and organics challenging. Analysis of samples retrieved directly from an asteroid would help us disentangle the effects of terrestrial weathering and asteroidal aqueous alteration and hence whether some of the exotic organics and large populations of presolar grains were affected by terrestrial processes in meteorites. Considerable textural information may be preserved in the returned sample based on GRO 95577 textures [10]. If Bennu is a CR1, or is CR1-like, some other B-type asteroids may be CR1-like as well. Magnetite identified in Bennu spectra also may support telescopic identifications of magnetite in some B-type asteroids [11]. If Bennu is comprised of CR1(-like) material, in whole or in part, the Bennu sample represents a remarkable opportunity to study in depth what is currently a unique material among carbonaceous chondrites.

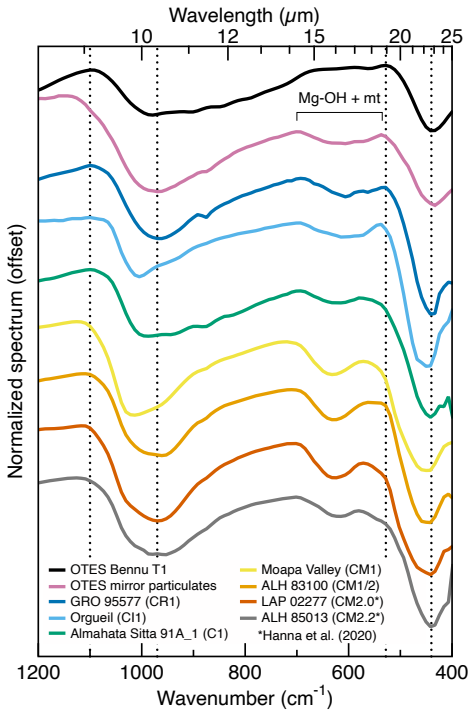

Fig. 1. Bennu spectra [3, 9] in comparison to aqueously altered carbonaceous chondrites. Vertical lines are at 1100, 987, and 528 cm^{-1}. ALH=Allan Hills; LAP=LaPaz Icefield.

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