Gaussian Deconvolution of the 2.7-µm Absorption Band of Type 1 and 2 Carbonaceous Chondrites for Interpreting Hayabusa2 Near-Infrared Spectrometer (NIRS3) Data

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Introduction: Continuing our previous work of deconvolving the composite 3-µm absorption band of type 1 and 2 carbonaceous chondrites (CCs) to derive the correlation between the 2.7-µm hydroxyl absorption band characteristics and CC types [1], in this study we have expanded the number of CC reflectance spectra, and also converted them into simulated Hayabusa2 Near-Infrared Spectrometer (NIRS3) [2] in an attempt to help interpreting data of the asteroid 162173 Ryugu.

Experimental: In addition to the previously studied reflectance spectra (2.5-4 µm) of powder or pressed pellet samples of CCs (CImix: Ivuna-Orgueil mixture, Murchison and Y-793595 (CM2), Renazzo (CR2), and Tagish Lake) [1], spectra of UV-irradiated Murchison and laser-irradiated Y-793595 pellet samples, powder samples of Kaidun and 15 CM2 chondrites including MET 00639 (probably shocked), and a chip sample of MIL 13005 (CM1/2) have been either newly measured or taken from the RELAB database [3].

Method: Following our previous study [1], natural log reflectance spectrum of each sample was deconvolved into a linear continuum background and Gaussians (both in wavenumber) over a wavelength range from 2.67 µm to around 3.8 µm. Gaussians centered beyond about 2.8 µm were regarded as due to adsorbed water or organics [4] and removed from the natural log reflectance spectrum, the remaining portion was restored to the reflectance space, and resampled to the NIRS3 bands.

Results: Examples of those Gaussian deconvolutions of simulated NIRS3 spectra of the CC samples are shown in Fig. 1. These deconvolution calculations used only two Gaussians for the hydroxyl bands, although the original laboratory spectra may have taken three to fit. The band centers and the relative strength of these two bands are plotted in Fig. 2. There seems to be a trend that aqueous alteration, shock, and space weathering all shift band centers toward shorter wavelength.

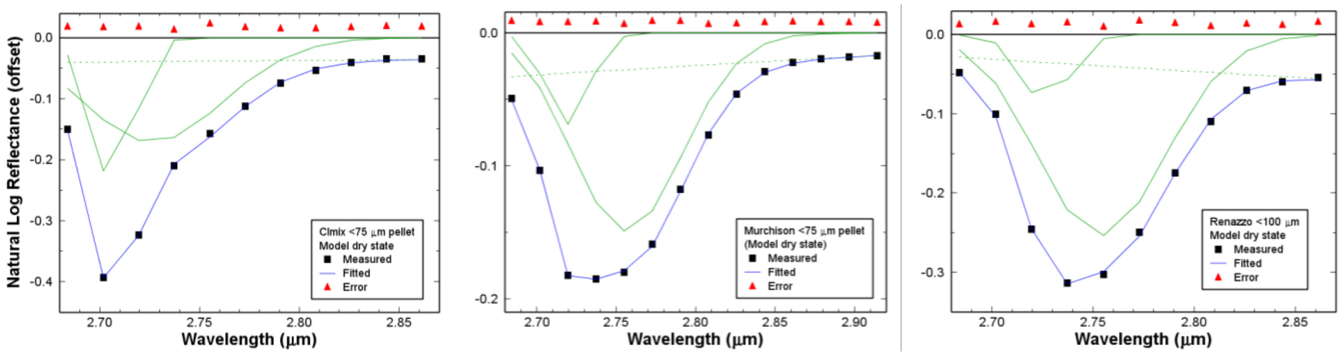

Figure 1. Examples of Gaussian deconvolutions of NIRS3-simulated spectra of type 1 and 2 carbonaceous chondrites.

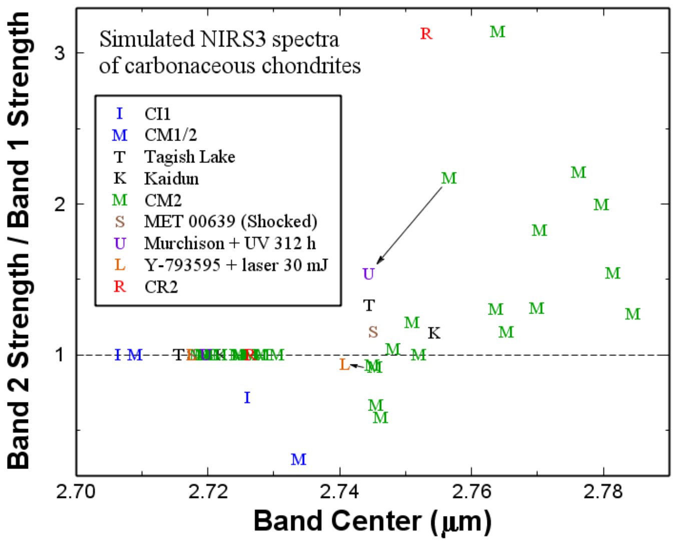

Figure 2. Band centers and relative strength of two hydroxyl bands of model spectra of CCs such as those shown in Fig. 1.

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