PRINCIPAL COMPONENT ANALYSIS OF VISIBLE-NEAR-INFRARED REFLECTANCE SPECTRA OF SELECT CARBONACEOUS CHONDRITES FOR HAYABUSA2 MISSION.

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Introduction: Hayabusa2 spacecraft has two onboard instruments ONC-T and NIRS3 whose data can reveal compositional of the target C-type asteroid. We have studied how to distinguish different carbonaceous chondrite (CC) types using spectral bands of these two instruments by applying the principal component analysis (PCA) to the laboratory visible and near-infrared (VNIR) reflectance spectra of CCs. The effects of carbon content and space weathering have also been studied.

Spectral Data: VNIR spectra (0.3-3.6 μm) of about 20 fresh CC power samples were taken from RELAB database. In addition, a similar spectral set of about 50 CC chip samples stored at NIPR taken by our recent VNIR spectral survey [1] was also utilized as a reference. While the first set of spectra are high in quality, the second set of spectra of the NIPR meteorites have much more diversity in texture and degree of terrestrial weathering. Spectral data of our pulse-laser irradiation experiments of CC pellet samples [2] were also employed.

Method: Each VNIR spectrum was resampled into simulated ONC-T and NIRS3 spectral band data. For practical purposes, only four bands were chosen for each instrument: 390, 550, 700, and 860 nm for ONC-T, and 2650, 2800, 2950, and 3100 nm for NIRS3. Also, the four band data were normalized by one band data (550 nm for ONC-T, and 2650 nm for NIRS3). Therefore, those three band ratio data were employed variables for PCA of simulated data by each instrument.

Results: The PCA of the simulated three ONC-T band ratios of 21 CC powder samples revealed that the principal components 1 and 2 could distinguish four groups of CC types: CI1, CM2, Tagish Lake, and CR/CV/CO/CK/Dehydrated. On the other hand, the PCA of the simulated NIRS3 data of 20 CC powder samples could distinguish six groups of CC types: CI1, CM2, CR2, Tagish Lake, Dehydrated, and CV/CK. Both the increased carbon content and lower degree of space weathering lowers the 390 nm reflectance according to past studies.

Summary: Because our PCA was performed with high-quality reflectance spectra of a small number of fresh CC powder samples, the result may look promising. On the real surface of the target asteroid, the UV (390 nm) darkest area may have the least space-weathered and/or carbon-rich CC material, whose composition may be the easiest to identify.

References: [1] Hiroi T. et al. 2011. *Polar Science* 5:337-344. [2] Hiroi T. et al. 2013. Abstract #1276. 44th Lunar & Planetary Science Conference.