Linking Outer Main Belt Asteroids with Carbonaceous Chondrites

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Outer Main Belt (OMB) asteroids, spanning heliocentric distances 2.5 < a < 4.0 AU, are mainly carbon-rich and primitive asteroids that record the earliest history of our Solar System. Telescopic observations of these asteroids are important to constrain many questions related to the abundance and distribution of water and organic material in the early Solar System, and their significant roles in the cosmochemical evolution of many diverse Solar System bodies. Members of some OMB asteroidal spectral classes, especially among the C-complex, are widely thought to be linked to CM and CI carbonaceous chondrites. In our investigation of OMB asteroids, we have observed 45 asteroids in the 3-μm region and we are planning to observe 60 more asteroids in the next 3 years using the NASA Infrared Telescope Facility (IRTF) and Gemini North telescopes. Thus far, the investigation has allowed the identification and distribution of at least four 3-μm spectral groups, each of which is presumably related to distinct surface mineralogy. A supporting study examined spectra of CM and CI carbonaceous chondrites in the laboratory. In this study we identified three spectral groups of CM chondrites (in addition to the CI chondrite Ivuna) on the basis of the 3-μm band center and shape of spectra, showing that distinct parent body aqueous alteration environments experienced by different carbonaceous chondrites can be distinguished using reflectance spectroscopy. Spectral comparisons of meteorites and asteroids have been challenging because meteorite spectra were usually acquired in ambient terrestrial environments, and hence were contaminated by atmospheric water. In our study, however, meteorite reflectance spectra were measured under dry conditions (vacuum and elevated temperature) to mimic space conditions and minimize the adsorbed water that affected previous analyses. We will show in this presentation that 3-μm reflectance spectroscopy is crucial in linking primitive asteroids with carbonaceous chondrites.