ARE CARBONACEOUS CHONDRITES APPROPRIATE ANALOGS FOR SMALL BODIES IN THE OUTER SOLAR SYSTEM?

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An Observational View of the Outer Solar System: Hypotheses of the dynamical evolution of the solar system predict that, generally, present-day small bodies in the giant planet region initially formed at larger heliocentric distances (e.g. [1-2]). Although the reflectance properties of various populations do indeed vary with heliocentric distance (as reviewed by [3]), hypotheses of differential processing of volatile materials may reconcile these differences to remain consistent with formation from a common source [4]. Detailed reflectance spectroscopy measurements of the surface materials in these populations is limited due to their observational faintness coupled with an incomplete understanding of how their reflectance spectra, which are often devoid of diagnostic information, map to physical compositions and meteorite analogs. Therefore, learning how dark, potentially icy bodies in the solar system may or may not share common origins requires advancing knowledge of their present surface compositions with a better understanding of how their surfaces have evolved.

Often, the nature of opaque, darkening components on outer solar system surfaces is based on spectral models which incorporate amorphous carbons or other neutral absorbing agents (e.g., [5-7]). Study of the small Neptunian satellite Nereid found that magnetite is a suitable material its surface, as simple Hapke mixtures of magnetite with water ice can recreate many of its spectral properties [8]. Basic models of primitive outer solar system compositions can be built upon searches for spectral evidence of volatile ices (like water or CO2), then matching albedo and spectral slope by incorporating a dark opaque and/or a reddening agent (often thought of as complex organics, like tholins, [9]). By establishing links between the outer solar system and meteorite properties, we aim to better inform such simplified compositional models.

How Can We Incorporate Information From Carbonaceous Chondrites? Carbonaceous chondrites (CCs) present an opportunity to strengthen our understanding of how dark, primitive objects compare with each other *and* understand what causes these differences. Studies of CC reflectance properties find that a variety of noncompositional effects have myriad effects on their spectral properties ([10], see also the abstract by Cantillo et al. at this conference). This includes radiation environments, grain size, and texture. The possibility of alteration from bombardment by cosmic rays may contribute to the signatures of water ice bands observed on Nereid [8]. Such processing would likely impact the opaque materials as well, as experiments studying irradiation of CCs like Tagish Lake have found complex spectral changes to occur [11].

Primitive CCs, particularly CI chondrites, are useful for this purpose due to their low albedos and spectral variability (for instance, the CI chondrites Alais and Ivuna display large differences in color/spectral slope, see [10]). This framework does not require that CCs represent direct samples of outer solar system materials, but utilizes them as examples of complex, low-albedo mixtures whose behavior can be studied in detail.

New Observations: We present visible wavelength (~0.4-0.9) spectra obtained at the Large Binocular Telescope Observatory of several faint Uranian satellites and Neptune Trojans. Such objects are challenging to observe using large ground-based telescopes. We will discuss how interpretations based on primitive CI- and CM-chondrites as spectral analogs can be useful for making predictions of the variability of these surfaces. We discuss constraints that future telescopic observations can place on the material compositions of these objects.

Acknoweledgements: This work was supported by a NASA Earth and Space Science Fellowship (80NSSC18K1252, PI: Sharkey).

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