

REFLECTANCE SPECTROPHOTOMETRY OF THE IRREGULAR OUTER JOVIAN SATELLITES AS INSIGHT TO SOLAR SYSTEM HISTORY. Faith Vilas¹, Planetary Science Institute (1700 E. Fort Lowell Rd., Tucson, AZ 85719, fvilas@psi.edu).

Introduction: The structural traits of our Solar System, including physical distribution of objects out through the Kuiper Belt, are not yet fully understood. Unifying these diverse characteristics has been the subject of multiple dynamical studies of the Solar System. The recent “Nice model” [1,2,3] describes a scenario in which the Jovian planets experienced a violent reshuffling event ~3.9 Gyr ago. In this process, gravitational interaction with planetesimals leaving the planetesimal disk induced slow planetary migration in the jovian planets. Eventually, Jupiter and Saturn crossed their mutual 1:2 mean motion resonance, triggering a reorganization of the Solar System: giant planets moved, existing small body reservoirs were depleted or eliminated, and new small-body reservoirs were created. The Nice model explains quantitatively, the origins of orbits of the Jovian planets and Neptune [1], orbits of bodies in several different small body reservoirs in the outer solar system (e.g., the jovian Trojan asteroids) [2], the irregular satellites of the giant planets [4], the Kuiper Belt and scattered disk objects [5], and the late heavy bombardment on the terrestrial planets ~3.9 Gyr ago (e.g., [3][6]).

The Nice model predicts that transported KBOs should dominate in the outer part of the main asteroid belt. Based on existing observations of the KBOs, these main-belt asteroids should appear dark and show increasing reflectance with increasing wavelength (“reddening”). Spectral evidence shows, however, that the outer main asteroid belt is dominated by the grossly spectrally neutral (“grey”) C-type asteroids from 2.6 to 3.2 AU. Approximately 50% of these C-type asteroids also show absorption features in the 0.3- to- 3.5 μm range suggesting aqueous alteration (the alteration of material by the interaction of that material with liquid formed by melting of incorporated ice) (c.f., [7]). Bottke et al. [8] argue that more than 90% of the objects captured in the outer main belt could have been eliminated by impacts in the violent reshuffling episode, if they had been weakly-indurated objects. These disrupted objects should have left behind pieces in the ancient regoliths of other – presumably stronger – asteroids. Until recently, the observed aqueous alteration absorption features have generally not been detected in spectra of D-class asteroids. The existence of features attributed to aqueous alteration products has, however, been suggested in the reddened broadband photometry spectra of outer irregular jovian satellites, and some outer-belt D-class asteroids [9].

New Observations and Analysis: A common absorption feature centered near 0.7 μm and attributed to an $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+}$ charge transfer transition in oxidized iron in phyllosilicates - products of aqueous alteration - is found in spectra of roughly 50% of the C-type asteroids, and suggested in some of the reddened broadband photometry of the jovian irregular satellites [9]. Moderate resolution VNIR narrowband spectroscopy was obtained of the jovian irregular satellites JVI Himalia, JVII Elara, JVIII Pasiphae, JIX Sinope, JX Lysithea, JXI Carme, JXII Ananke in 2006, 2008, 2009, 2010 using the MMT Observatory facility Red Channel spectrograph to confirm the presence of this feature. The spectra are centered near 0.64 μm in order to cover the 0.7- μm feature entirely (generally ranging from 0.57 to 0.83 μm). These spectra sample the prograde ($i = 28^\circ$), two retrograde ($i = 149^\circ, 165^\circ$) and independent satellites. The initial analyses of these spectra indicate that two similar absorption features exist in this spectral region, varying by satellite grouping and suggesting different parent bodies. These data will be discussed in the context of compositional similarities with C and D type asteroids.

References: [1] Tsiganis K. et al., (2005) *Nature* 435, 459 - 461; [2] Morbidelli A. et al. (2005) *Nature* 435, 462 - 465; [3] Gomes R. et al. (2005) *Nature* 435, 466 - 468; [4] Nesvorný D. et al. (2007) *Ap. J.* 133, 1962 - 1976; [5] Levison H. et al. (2008) *Icarus* 196, 258 - 273; [6] Strom R. et al. (2005) *Science* 309, 1847 - 1950; [7] Rivkin A. et al. (2002) In *Asteroids III*, 235-253; [8] Bottke W. et al. (2008) *LPSC XXXIX* Abstract #1447; [9] Vilas F. et al., (2006) *Icarus*, 180, 453; [10] Vilas, F. (2010) *BAAS* 42, 91.