CRATER SHAPES ON GIANT PLANET ICY SATELLITES AND APPLICATIONS TO NEW HORIZONS AT THE PLUTO-CHARON SYSTEM.

O.L. White[1] and P.M. Schenk[1]. [1]Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, Texas, 77058 (white@lpi.usra.edu; schenk@lpi.usra.edu).

Impact craters are a virtually ubiquitous morphological feature on most of the giant planet icy satellites. Given their frequency, they often represent the only morphological features that can provide information on the rheological and thermal states of the crusts of these bodies. Previous research has used Voyager, Galileo and Cassini images to infer the depth/diameter ratios of craters on moons orbiting Jupiter, Saturn and Uranus [1, 2, 3, 4]; for some of these moons, these statistics have been used to gauge the extent to which crater morphologies have viscously relaxed since formation, and from this constrain scenarios for the histories of the moons' thermal gradients and their upper rheological structure [2, 4].

The New Horizons mission, which will arrive at the Pluto-Charon system in summer 2015 [5, 6] will fly by worlds that are comparable to the icy satellites of Saturn and Uranus with respect to their size, ice-rock ratio and degree of differentiation [7]. Variations in these properties will influence parameters such as gravity, crustal rheology and heat flow, each of which will in turn influence crater morphology during formation and subsequent modification. The extent to which cratering has modified the surfaces of Pluto and Charon will remain unknown until the rendezvous of New Horizons. This presentation will discuss how current estimates of the aforementioned physical parameters for Pluto and Charon may influence their crater morphologies on based on observations at the giant planet satellites.

Surface gravity is a property of planetary bodies that has been shown to be highly influential on crater depth/diameter ratio; specifically, higher surface gravities will result in lower depth/diameter ratios of complex craters [4, 8]. Pluto displays a surface gravity of 0.658 ms^{-2}, intermediate to the gravities of the mid-sized icy satellites of Uranus and Saturn and the cratered Galilean satellites of Jupiter; Charon displays a surface gravity of 0.278 ms^{-2}, very similar to that of Iapetus and Rhea, the largest of Saturn's mid-sized satellites.

The proportion of rock to ice within these bodies, and their differentiated or undifferentiated state, will influence crustal rheology and by analogy crater morphology, both with respect to the high proportion of ice in the crust as well as heat flow caused by decay of radioactive isotopes. Observations by the Hubble Space Telescope indicate a density for Pluto of 1.83 to 2.05 g/cm^3, and a density for Charon of 1.59 to 1.83 g/cm^3; these values imply rock/ice mass ratios ranging from 56:44 to 77:23 [9]. By comparison, estimates for Saturnian satellite rock/ice ratios range from 6:94 (Tethys) [10] to 62:38 (Enceladus) [11], while estimates for Galilean icy satellite ratios range from 45:55 (Callisto) to 94:6 (Europa) [12]. Bodies with higher estimated rock/ice ratios such as Enceladus and Europa are observed to display more extensive relaxation across a wider range of crater sizes relative to those with lower ratios.

Pluto and Charon display a higher rock/ice mass ratio than many of the satellites of Jupiter or Saturn, but a similar proportion to Neptune's moon Triton (estimates range from 70:30 to 55:45), which may itself be a captured Kuiper belt object [13]. Given that Pluto and possibly Charon are currently thought to be differentiated bodies with ice-rich mantles surrounding rocky cores (that of Pluto is thought to have a diameter 70% of the total), radioactive decay in their large cores may supply enough heat to the icier surface material to cause considerable crater relaxation and even elimination through melting and cryovolcanic resurfacing. The midsize Saturnian satellites may give us a foretaste of how crater modification might have occurred on Charon and perhaps Pluto as well.

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