INVESTIGATION OF SECONDARY CRATERS IN THE SATURNIAN SYSTEM. T. Hoogenboom[1], P. Schenk[1] and O. White[1], [1]Lunar and Planetary Institute (3600 Bay Area Blvd, Houston TX 77058; Hoogenboom@lpi.usra.edu).

Introduction: At present, surface ages of bodies in the outer solar system are determined only from crater densities (a method dependent on an understanding of the projectile populations responsible for impact craters in these planetary systems). To derive accurate ages using impact craters, the impact source must be determined. Impact craters can be primary, secondary or sesquinary. Primary craters are made by direct impact of comets or asteroids. Secondary craters are produced by impact of ejecta thrown some distance away by a primary impact on that same body. Secondary craters are more heavily influenced by surface mechanical properties than their larger counter parts.

Our objective is to better understand the contribution of (dispersed) secondary craters to the small crater population (e.g. [1]), and thereby ultimately that of small comets to the projectile flux on large icy satellites. In this study we investigate the origin of secondary craters in the larger context. We measure the diameter of obvious secondary craters (determined by irregular crater shape and small size) created by Inktomi (a 48 km diameter crater on Rhea). While focusing on Rhea, we also investigate secondary crater size/frequency/distribution/formation and secondary crater chain formation on icy satellites throughout the Jupiter and Saturn systems.

Inktomi Background: Located at 14.1S, 112.1W, Inktomi is a large, prominent bright ray crater on the icy surface of Rhea, Saturn's second largest satellite (Figure 1). Cassini observed Inktomi in September 2007 (orbit 49) at high resolution, in color, and stereo, (providing one of the best color topographic maps of Saturn's icy satellites). The Inktomi mosaic is at a base resolution of 40 m/pixel. Inktomi is defined by steep 6 to 7 km high rim wall "cliffs". Inktomi is the youngest of Rhea's many large impact craters, and most likely formed within the last few million years. Ray craters are morphologically fresh and superimpose other geologic units and are straigraphically young. Rolling hills on the floor of the crater are debris mounds formed when portions of the rim collapsed onto the crater floor. The butterfly wing ejecta pattern indicates an oblique impact from the west [2]. Recent analysis of VIMS data revealed clean H_2O ice without impurities at the crater and in its ejecta. No evidence of endogenic activity has been discovered [3].

Secondary Craters Associated with Inktomi: The surface beyond the rim has been covered and scarred by icy material ejected from within Inktomi. Evidence for flow of material is found throughout the continuous ejecta deposit. As such a continuous ejecta blanket is observed which is largely devoid of small craters. Abundant radial secondaries occur beyond the continuous ejecta blanket associated with the bright rays. Though there are important exceptions, secondaries generally occur at a distance *De* calculated by $De = 4.931\ Dc^{0.85}$ [4] where *Dc* is the primary crater diameter. Secondary craters in our region of interest occur ~75 km from the center of Inktomi in general agreement with scaling of ejecta on low-gravity icy satellites.

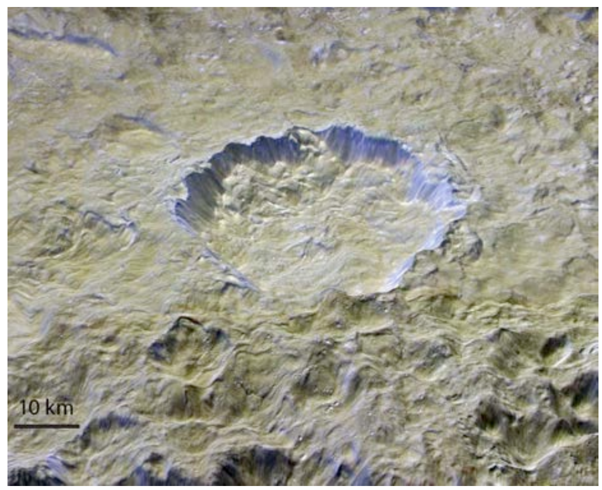

Figure 1: Perspective view of Inktomi based on stereo topography derived from Cassini imaging data.

Clusters of numerous small craters are also identifiable in the eastern floor of Inktomi and in the adjacent continuous ejecta [2]. These small craters most likely were created by material ejected at a steep angle [2,5].

Crater Counts: Secondary crater counts were made from new controlled image mosaics of Inktomi and identified based on irregular shape/small size. High-resolution imaging allowed craters down to 150 m to be resolved. We also investigate the occurrence of secondary crater chains and fit a great circle to the end points and midpoints.

Results and Discussion: A total of 497 secondary craters were counted in a 1296 km^2 region W-NW of Inktomi (Figure 2,3). Numerous NE-SW trending secondary crater chains were observed that are unique to the region. These may be radial to Inktomi. All data is presented in standard cumulative crater size plots (Figure 4) and in *R* plots (Figure 5). The cumulative plots display absolute crater densities, and the *R*-plots are in essence "normalized differential plots where the *D*-3 power-law" trend is divided out. Our counts (Figure 4,5), show a steep decline in smaller craters, which may be characteristic of secondary craters [1] but show some differences with previous counts [6]. These will be explored as counting on other icy satellites continues, including Dione, Tethys, Iapetus and Ganymede. We will further investigate secondary crater chain formation on the Saturnian satellites and under what mechanical conditions they form (e.g. fragments/boulder size of ejecta). Secondary crater depths will be calculated for the Saturn and Jupiter system satellites using shadow measurements/stereo imaging techniques. Secondary crater depths for Rhea [7] suggest shallow depths (mean d/D=0.08±0.03 km with mean crater wall slopes of α=9.6±3.1°) consistent with other bodies [1].

References: [1] McEwen. A.S & Bierhaus. E.B. (2006) *Ann. Rev. of Earth and Planet. Sci., 535-567*. [2]Wagner R.J., et al., (2008) *LPSC XXXIX, #1930.* [3]Stephan K. et al. (2010b), *PSS.* [4] Schenk & Ridolfi, (2002) *GRL, 29/12, 31-1*. [5] Greeley R. et al. (1982), in *Satellites of Jupiter* (D. Morrison, ed.), p. 340–378, Univ. of Arizona Press, Tucson, AZ. [6] Kirchoff, M. & P. Schenk, (2009) *Icarus*. [7] Rivera-Valentin et. al (this vol.).

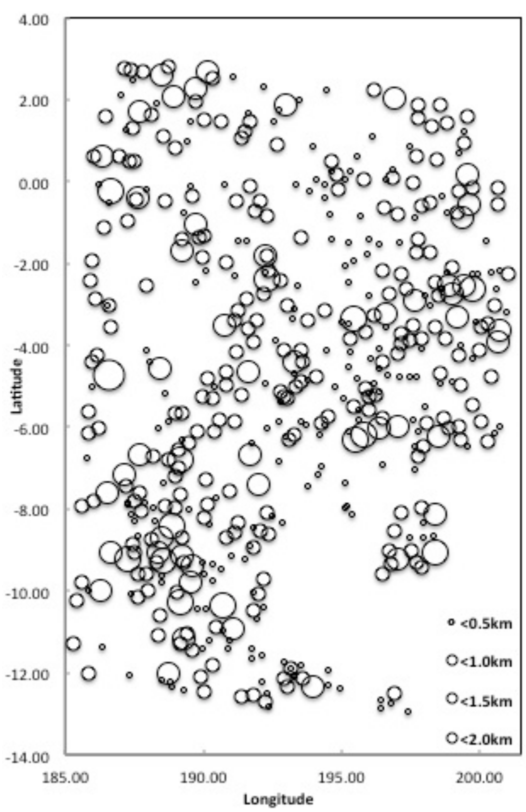

Figure 2. Map of secondary crater locations. Circle size indicates binned diameter of craters.

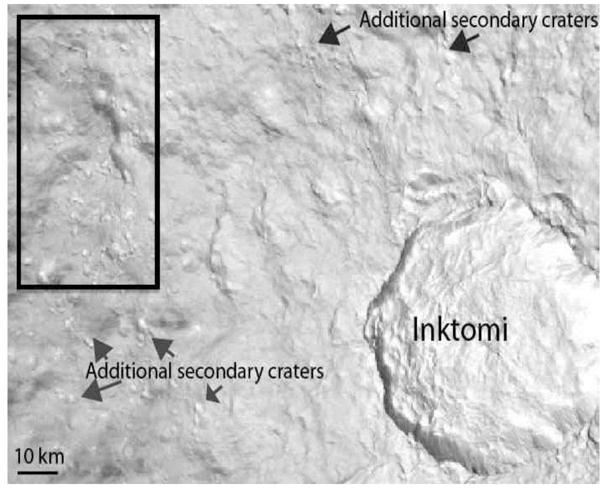

Figure 3: Location of secondary crater count region. (See Figure 2 for location).

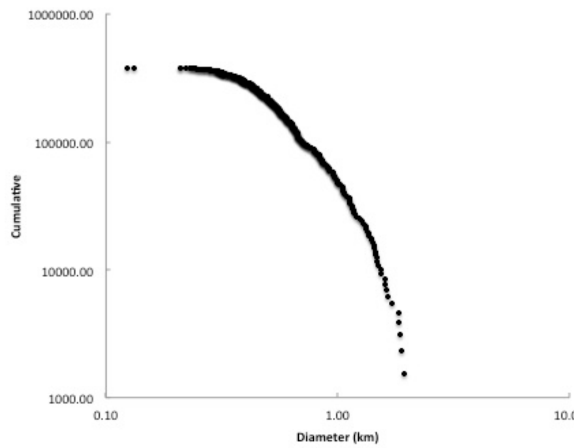

Figure 4. Cumulative size frequency distribution vs. crater diameter for crater count region.

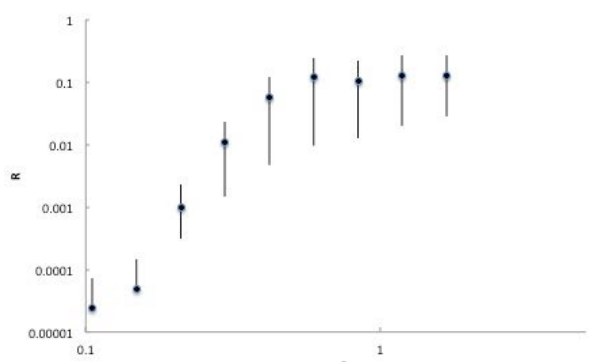

Figure 5. Relative (*R*) size-frequency impact crater distributions for secondary craters in 1296 km^2 region on Rhea . ± $\sqrt{N}$ error bars are given where *N* is the number of craters in a bin.