SIZE FREQUENCY DISTRIBUION AND EJECTION VELOCITY OF CORINTO CRATER SECONDARIES IN ELYSIUM PLANITIA. C. Bloom[1,2], M. Golombek[1], N. Warner[1], and N. Wigton[1,3], [1]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, [2]Occidental College, Los Angeles, CA 90041, [3]University of Tennessee, Knoxville, TN 37996

Introduction: Corinto crater is a 13.9 km diameter fresh rayed impact crater in Elysium Planitia on Mars. Corinto crater is elliptical and has an asymmetric lobate ejecta suggesting an oblique impact from the north-east (Fig. 1). A combination of high and low thermal inertia lobes containing secondary craters were identified and surveyed radial to Corinto Crater [1]. Here, we describe our mapping results of Corinto secondary rays, quantify the size frequency distribution of secondary craters in the rays, and estimate the ejection velocity necessary to produce the most distant secondaries.

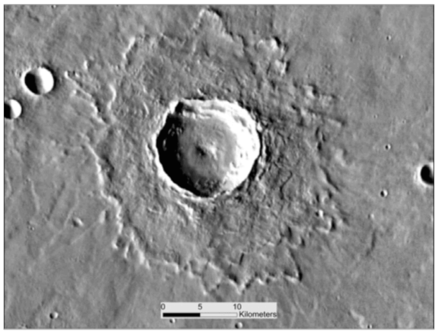

Figure 1. Corinto crater located at 16.95°N, 141.7°E in THEMIS mosaic.

Data: For mapping, we used day-time and night-time thermal infrared images from the Thermal Emission Imaging System (THEMIS) and georeferenced visible light images from the High Resolution Imaging Science Experiment (HiRISE) and the Context camera (CTX).

Crater Ray Mapping: Detailed mapping was performed on distinct dark elongate ray-like forms that dominate the region ~1400 km south of Corinto and are observed radiating directly from Corinto in nighttime thermal. The rays were not readily visible in daytime images but are dark in the nighttime thermal mosaics indicating low thermal inertia similar to other distant rays [2,3]. This low thermal inertia, typically associated with dust, suggests that dust may have been sintered in the ejecta of secondary craters [2]. Corinto impacted surface material similar to other Martian rayed craters in terms of albedo, thermal inertia, and dust cover yet its rays appear far more extensive.

HiRISE and CTX over the rays demonstrate that they are composed of dense swarms of secondary craters. We have identified three facies of rays with increasing distance from Corinto.

The first facies is up to 5 km wide and exhibits dense secondary craters at the CTX scale. The rays begin at the edge of the Corinto ejecta blanket and extend southward up to nine crater diameters from the primary impact site (~120 km). To the north, they extend four crater diameters (~60 km). While the secondary craters can be resolved in CTX they are not visible in thermal imagery, with diameters that range from 50 m to 350 m.

The second facies of rays is composed of dense groupings of secondaries in large elongate lobes that are up to 50 km wide and 100-300 km in length, extending south of Corinto from nine crater diameters (~125 km) up to 22 diameters (~310 km). The secondary craters in this facies are resolved in CTX with diameters exceeding 350 m.

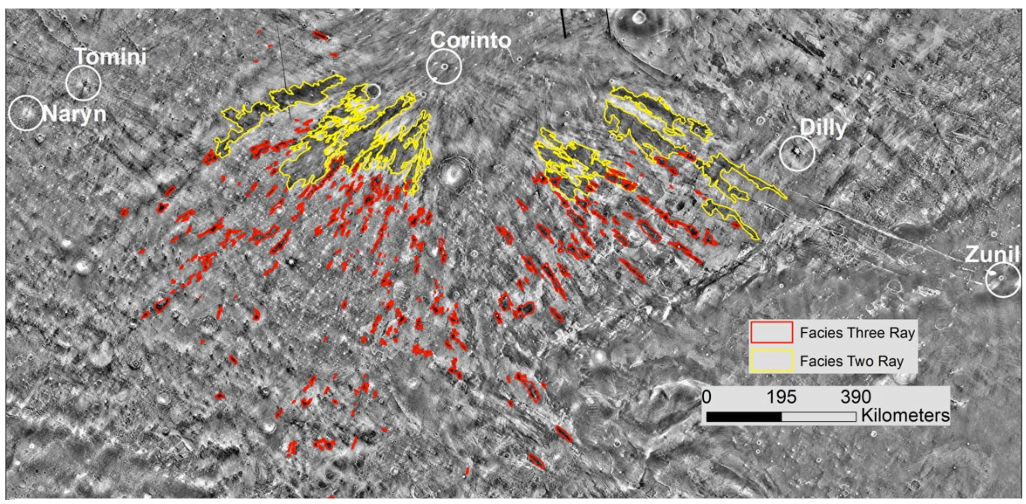

Figure 2. Fresh rayed craters (circled in white) in and arond Elysium Planitia in THEMIS mighttime mosaic. Facies two (yellow) and three (red) rays radial to Corinto crater.

The third facies of rays are the darkest in nighttime THEMIS images indicating that they have the lowest thermal inertia. These rays extend radially south from 21 Corinto diameters (~300 km) to as far as 100 diameters (~1400 km). An oblique impact explains the presence of facies two and three rays exclusively to the south of Corinto. Individual rays in facies three are the narrowest of all three facies (up to 14 km wide) and are several km to over 100 km in length. Craters in this facies are typically 7 to 15 m in diameter and are resolvable in HiRISE.

Age of Corinto: Mapping of secondaries from Corinto constrains the age of Corinto crater to between 0.1-1 Ma and 2.8±0.5 Ma [1]. Characteristic light-toned ejecta surrounds facies three secondaries. Secondary craters with this characteristic ejecta are observed superposed on young Cerberus, Athabasca flood, lavas in the Western Lava Basin dated to be 2.8±0.5 Ma [4]. Furthermore, a ray of secondary craters that is radial to the 10 km diameter Zunil crater, 1400 km to the east (see figure 2), produces smaller craters without obvious ejecta that are superposed on the characteristic ejecta of Corinto secondaries [1]. Zunil crater is estimated to be 0.1-1 Ma [5] constraining the age of Corinto as older than Zunil crater and younger than the Western Lava Basin lavas.

Size Frequency Distribution (SFD) of Secondary Craters: We characterized the size frequency distribution (SFD) of Corinto secondary craters within facies 2 and 3 to evaluate relationships between ejection distance, cumulative crater density and size. Specific rays were chosen for analysis based on HiRISE availability. For facies 3 in western Elysium Planitia, we take advantage of the relatively dense HiRISE coverage provided by the InSight landing site characterization efforts. Crater counts were plotted as cumulative distributions on a log-log plot for all crater diamaters >5 m (Figure 3). Relevant data for two representative examples are presented in Table 1.

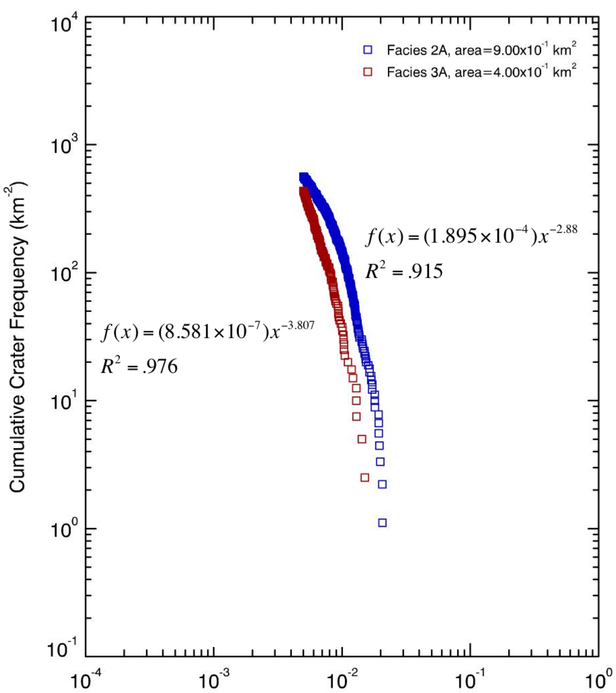

Figure 3. 5m diameter and larger craters plotted as a log-log cumulative distribution of type two (Blue) and three (Red) rays with power functions.

Diameter:	**Facies 2 (Cum No. Craters/km^2)**	**Facies 3 (Cum No. Craters/km^2)**
15 m	2	0.25
10 m	150	54
5 m	566	450

Table 1. Crater count data for Facies 2 and 3 rays at 15, 10, and 5 m diameters.

The cumulative distribution curve for each facies follows a power law slope near -3, a steeper slope than the power law production functions that include primary craters and far-field random secondaries [5]. Facies two rays have a power law slope of -2.88 and facies three rays have a slope of -3.81 at >5 m diameter compared to Zunil crater rays with a slope of -4.9 at >15 m diameter [6]. As expected from qualitative observations, the cumulitive frequency of craters at each diameter bin is lower for Facies 3 relative to Facies 2.

Ejection Velocity: Previous work for Zunil crater utilized a ballistic range velocity equation to determine ejection velocity of fragments from secondary range and angle of ejection [6]:

$$v_e = \left[\frac{R_p g \tan(x/2R_p)}{\tan(x/2R_p)\cos^2\Phi_e + \sin\Phi_e\cos\Phi_e}\right]^{1/2}$$

where v_e is the ejection velocity, x is a fragments range from the primary impact, g is the gravitational acceleration (3.71 m s^{-2} for Mars), R_p is the Mars equatorial radius (3396.20 km), and Φ_e is the ejection angle. Using a Corinto ray within the most distal region of facies 3 at a range of 1700 km, and an ejection angle of 45° (the typical ejection angle for a normal impact [6]), we estimate an ejection velocity of 2.27 km s^{-1}. As a comparison, the most distant secondary crater from Zunil crater was estimated around 2.2 km s^{-2}. However, our preliminary observations of relatively fresh crater rays to the south of the 1700 km ray indicate the possibility that the Corinto impact produced secondaries out to a much greater range (possibly 2240 km). Future mapping and crater counting in this distal region, using HiRISE and CTX will be carried out to identify additional Corinto secondaries.

References: [1] Golombek M. et al. (2014) *LPSC* #1470; [2] McEwen A. et al. (2005) *Icarus 176*, 351–381. [3] Tornabene L. et al. (2006) *JGR 111*, E10006. [4] Vaucher J. (2009) Icarus 204 , 418-442. [5] Hartmann W. et al. (2010) *Icarus 208*, 621–635. [6] Preblich B. et al. (2007) *JGR* 112, E05006.