CHARACTERIZATION OF A CORINTO CRATER RAY ON MARS L. ONG[1], A. J. BERGER[2], H. J. MELOSH[2] [1] Dept. Planetary Sciences, University of Arizona, Tucson, AZ 85721 (long@lpl.arizona.edu), [2]Dept. Earth and Atmospheric Sciences, Purdue University, West Lafayette, IN 47907.

Introduction: Millions of secondary craters have been discovered within the distant crater rays of modestly sized (10-20 km) primary craters on Mars [1]. The number of craters within these rays suggests that primary impact events likely produce distal secondaries that do not lie within crater rays and are indistinguishable from small primary craters. Young martian surfaces are dated by a few small primary craters, and the presence of unrecognized secondaries introduces uncertainties in surface ages based on these small craters [2,3]. Clustering of craters within crater rays shows their formation to be different from single distal secondary craters, but the characterization of secondaries within rays can shed light on the possible fragment sizes of high-velocity crater ejecta. We measured the number, distance, and size-frequency distributions of secondary craters within a Corinto crater ray.

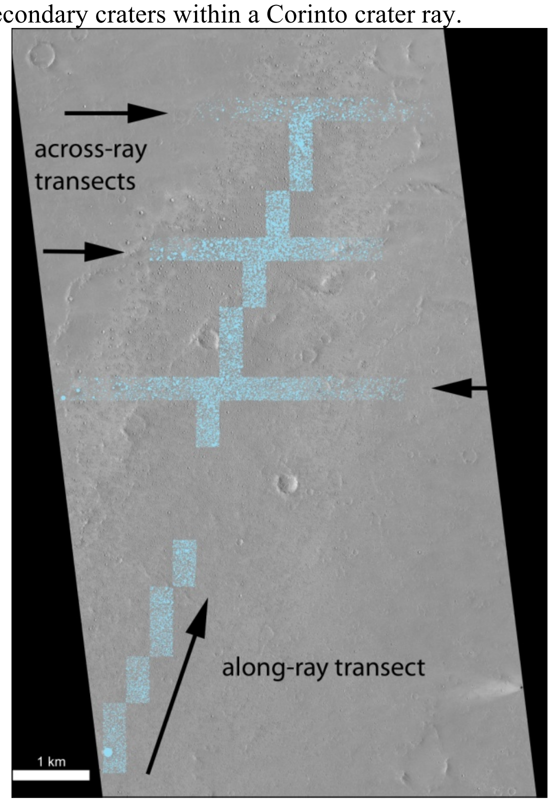

Fig. 1: Subset of HiRISE image PSP_006512_1910 showing a Corinto crater ray segment with measured craters marked in blue. We counted 18,000 secondary craters in one along-ray and three across-ray transects.

Corinto crater ray and morphology: Corinto is a 13.8 km-diameter central pit crater located within the dust-mantled region of Elysium Mons. Its far-reaching crater rays are identified through thermal inertia measurements [4]. We measured craters within a 9 km by 3 km ray segment located 360 km S-SW of Corinto.

To measure size-frequency-range distributions of secondary craters in the ray, we divided the ray into a square grid 300 meters wide. We measured craters in one transect along the crater ray ranging 9 kilometers and three transects across the ray, the widest of which is 4.5 km long (Fig. 1). We measured the diameter of each crater greater than 3 meters in diameter (12 pixels) by fitting circles around the crater rim in the image-processing program ENVI.

Results: We measured nearly 18,000 craters within 55 grid cells that covered 4.95 km^2 with crater diameters ranging from 2 to 50 m and a single crater measuring 80 m in diameter.

Along-ray size-frequency: Crater frequency increases with distance from Corinto (Fig. 2). The crater densities range from 350 to 500 craters per measured unit area, or 4000 to 5500 craters per km^2. The HiRISE image only contains a segment of this crater ray, so it remains unclear if the total number of craters decreases gradually towards the far end of the ray, or whether it continues to increase before dropping off precipitously.

The slopes of the cumulative size-frequency distribution become steeper with increasing distance from Corinto. The increasingly steep negative slopes show a smaller range of crater sizes with increasing distance from Corinto, and the mean size of the craters is smaller. In sum, craters measured per grid cell become smaller and more uniform in size, but are more numerous with increasing distance from the primary.

Across-ray size-frequency: We measured craters along three transects of the crater ray, perpendicular to the direction of travel of the impactors. Secondary craters decrease in frequency with distance from the center of the ray (Fig. 3). We fit lines to each cumulative size-frequency distribution of the form $N_{>D(km)} = C - b\log(D(km))$. The exponent values become less negative with increasing distance from the center of the crater ray, indicating that near the ray center crater sizes are more homogeneous. With increasing distance from the ray center, however, the craters become smaller and crater diameters are more variable.

The exception to these trends occurs at the grid cell closest to the center of the ray. Here, the total number of craters is smaller than that of the adjacent cell. However, the smallest craters measured are larger than those of the neighboring cells. This suggests that at the center of the ray, the surface may approach geometric saturation, in which the larger craters are overprinting or precluding the formation of smaller craters. Conversely, the ejecta cloud that forms the ray might have concentrations of large fragments near the center and decreasing fragment size with increasing distance from the center of the ray.

Along-ray fractional area covered: The fraction of the surface area covered by secondary craters decreases with increasing distance from the primary crater. Although the number of craters increases with distance from the primary, the decrease in crater diameter dominates with the net effect of decreasing surface coverage. The high crater densities within the ray are reflected by the maximum fractional area covered by the craters, 0.62, compared with the cubic closest packing of identical circles of 0.78. This suggests one of the highest areal densities on a naturally occurring surface. Evidently the ejecta blankets of the ray secondaries do not obliterate adjacent craters to the extent seen with normal primaries, perhaps due to their near-simultaneous formation.

Summary and future work: We investigate the size-frequency-range distribution of secondary craters on Mars within a Corinto crater ray. Our crater counts within the ray show that crater diameter decreases with distance from the primary along the 9 km length of the ray. The number of craters increases with distance from the primary, but because the craters are smaller the surface area covered by the secondaries decreases with distance from Corinto. In addition, the crater sizes become more homogeneous with increasing distance from the primary. Across the ray, the crater density decreases with increasing distance from the ray center, as does the frequency of craters of a given size.

The areal density and size-frequency distribution of distal craters in this ray suggests a population very different from other small craters, and merits further study. We will extend our crater counts to areas where the crater density reaches the background crater density. The crater size-frequency-range statistics for areas where the crater density is lower and secondary impactors do not interfere with each other could provide insight into distal secondaries that are isolated from crater rays. This study shows a dramatic increase in crater density from the background at the ray boundary, but crater frequency distributions outside the ray also show many small craters. Whether these are Corinto secondaries, distal secondaries from another primary crater, or primary craters is unclear.

HiRISE and LRO images provide much-needed resolution to distinguish secondary crater populations from primaries. Additional crater counts along other crater rays would provide a useful comparison for size-frequency distributions across multiple rays. We will continue our characterization of secondaries within rays to help quantify the ejecta fragments sizes and velocities that could produce unrecognized distant secondary craters.

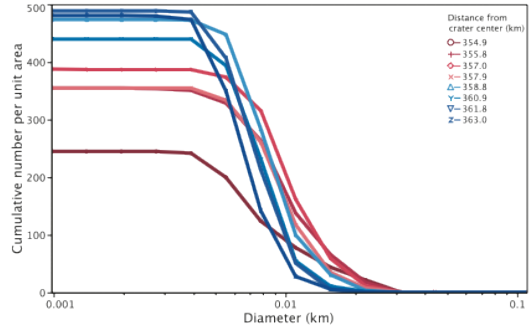

Fig. 2: Cumulative number of craters greater than a given diameter along the ray as a function of distance from Corinto (red to blue spectrum). Crater counts per unit area increase, but crater diameter decreases with increasing distance. Crater sizes also become more homogeneous with increasing distance from Corinto.

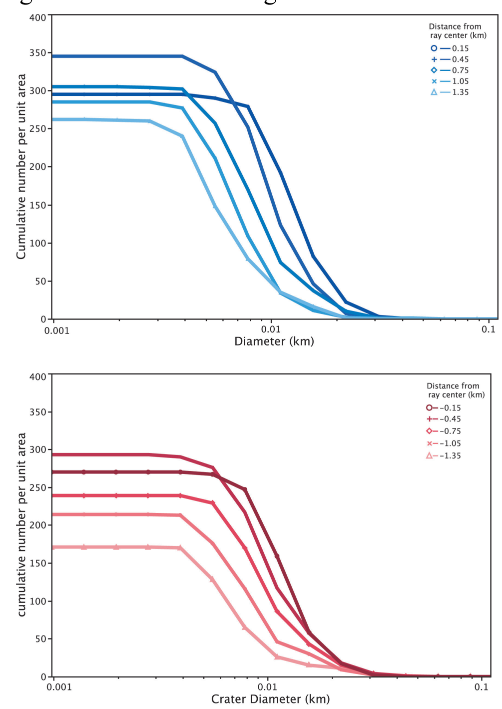

Fig. 3: Cumulative number of craters across a ray as a function of distance from the ray center eastward (blue, top) and westward (red). In both cases, the number of craters decreases with increasing distance from the ray center. Craters near the center of the ray are larger and more homogeneous in size than more distant craters.

References: [1] Preblich B. S. et al. (2007) *JGR, 112,* E05006. [2] Barlow, N. G. (1996) *LPI Contributions, 1320*, 12-13. [3] McEwen A. S. and Bierhaus E. B. *Ann. Rev. Earth and Plan. Sci. 34,* 535-567. [4] McEwen A. S. et al. (2010) *Icarus, 205,* 2-37.