Self-Secondary Crater Populations on Copernican Continuous Ejecta Blankets. M. Zanetti[1], B. Jolliff[2], C. H. van der Bogert[3], H. Hiesinger[3], J. Plescia[4], N. Artemieva[5]. [1]Western University, London, ON Canada (Michael.Zanetti@uwo.ca). [2]Washington University in St Louis, MO; [3]Westfälische Wilhelms-Universität Münster, Germany; [4]Johns Hopkins University / Applied Physics Laboratory, MD; [5]Planetary Science Institute, Tuscon, AZ.

Introduction: Continuous ejecta blankets were thought to completely resurface the area surrounding the parent crater (~1 crater radius from the rim) through ballistic sedimentation and the deposition of thick ejecta deposits [1]. The ejecta blanket should therefore be devoid of craters immediately following its emplacement, and the melt deposits and ejecta units should both accumulate subsequent craters at the production rate. However, recent measurements of small craters (<<1 km diameter) have shown a discrepancy in cumulative crater size-frequency distributions (CSFDs) and corresponding absolute model ages (AMAs) between the melt and continuous ejecta blankets at Copernican aged craters [2 -5], stirring debate between primary competing hypotheses of target material properties affecting measured crater diameters [e.g. 2, 6-9] or self-secondary cratering contamination [5, 10, 11].

Hypotheses for CSFD Discrepancy: Experiments and modeling show that crater diameter is dependent on the material properties of the target (e.g. competent impact melts produce smaller diameter craters compared with less competent ejecta units, and in turn have CSFDs and AMAs correspondingly lower than the ejecta) [6-9]. Target properties are suggested to account for up to 20% differences in crater diameter between melt and ejecta, and a crater diameter correction factor for target properties has shown promise to account for discrepancies [6-9]. However, target properties cannot easily explain all of the crater population differences and morphologic observations described below. Self-secondary craters (SSCs), a population of craters formed on the continuous blanket by late-arriving ejecta fragments from the parent crater [10], are an alternative possibility that can account for the melt/ejecta discrepancy.

Evidence for Self-Secondary Cratering at Tycho and Aristarchus: Crater density maps and CSFDs of large area counts of all craters >50 m diameter on the continuous ejecta at Aristarchus and Tycho (and elsewhere) crater show that the ejecta blankets accumulated more craters than impact melt deposits, irrespective of crater diameter. This deficiency of craters on ejecta persists even at LRO-NAC scale (>3m craters resolved). Large area counts also show an increasing crater density with distance from the parent crater rim and strong correlation of melt ponds and melt veneer with low crater density regions [5]. Morphological observations of putative ghost craters in impact melt ponds at Tycho crater, and craters infilled by flowing melt seen at Aristarchus, Tycho, Necho, and Giordano Bruno [5, 12-14] suggest craters formed on the continuous blanket in the short time between ejecta emplacement and melt solidification. With respect to a formation mechanism for SCCs, preliminary hydrocode modeling results of ejecta spallation and excavation suggest that high-angle ejecta (>80° launch angle with velocities of 0.8-1.2 km/s) capable of producing SSC impactors is possible for moderately oblique parent impacts [14]. The travel time of fragments can be >20 mins, allowing for the emplacement of the ejecta curtain and ballistic sedimentation to occur before impact into the newly formed continuous ejecta blanket.

Discussion and Implications: Self-secondary cratering provides a plausible explanation for the observed population differences between melt and ejecta, increasing crater density with distance from the parent crater rim, as well as morphological observations of melt-filled-craters and ghost-craters. Although target material properties are an important parameter in determining the final crater diameter, they do not account for the population differences measured on the continuous ejecta or ghost-craters. Target properties no doubt play a role in the observed melt/ejecta age discrepancy, and self-secondary cratering cannot be invoked to explain other issues with CSFDs and AMAs addressed by material properties (e.g. mare/highlands differences, thick vs thin regolith cover). If a population of self-secondary craters is produced by a parent impact event, then the production functions derived from CSFDs of craters on the continuous ejecta blanket of Copernicus, Tycho, North Ray, and Cone craters may not reflect the true impact flux of small crater (<500 m) forming projectiles for the inner Solar System. CSFDs measured on impact melt ponds, despite suffering from target material property effects, are the most likely surfaces to record the true impactor flux, which may necessitate a re-formulation of the lunar cratering chronology over the last ~1Ga.

[1] Melosh 1989 *Impact Cratering*, 245p and references therein [2] van der Bogert et al. 2010 LPSC 41, 2165 [3] Hiesinger et al. 2012 JGR 117, E2. [4] Xaio et al. 2012 Icarus 220, 254. [5] Zanetti et al. 2016 Icarus (in review). [6] van der Bogert et al. 2016 Icarus (in review). [7] Dundas et al. 2010 GRL. 37, L12203. [8] Wünnemann et al. 2012 LPSC 43,1805. [9] Prieur et al. 2016, LPSC 1988 [10] Shoemaker et al. (1969) *NASA Tech Rept* 32-1265 [11] Plescia et al. 2012 LPSC 1614 [12] Plescia et al. 2015 LPSC 2335 [13] Williams 2014 LPSC, 2882 [14] Artemieva and Zanetti 2016 LPSC 47, 2143