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Constraints on the Youngest Absolute Lunar Crater Chronology

Jeffrey Plescia (1) and Mark Robinson (2)

(1) Johns Hopkins University, Applied Physics Labatory, Laurel, United States (jeffrey.plescia@jhuapl.edu), (2) School of Earth and Space Exploration, Arizona State University, Tempe, AZ

Absolute ages for lunar geologic units are typically determined using a calibrated lunar cratering chronology [1-2], except for those cases where samples are available. The cratering chronology was calibrated using crater counts for surfaces that have radiometric dates (Apollo/Luna sam-ples). The youngest portion of the calibration is tied to two sampled craters - North Ray and Cone - and two for which samples are inferred to have come - Copernicus and Tycho.

Crater counts made with high-resolution LRO LROC images [3] for young craters (e.g., Giordano Bruno, Copernicus, Tycho, King) indicate that the counts on the continuous ejecta blankets do not reflect a primary production population and that the frequency of craters on the ejecta is typically several times greater than for the melt deposits associated with the impact [4-8]. The morphology and statistics of the small-impact craters on the ejecta indicate that the ejecta blankets are contaminated by significant number of self-secondary craters (as was originally proposed for Tycho by [9]). The difference in the crater frequency between the ejecta and melt surfaces indicates that the self-secondary cratering was largely over by the time the melt was emplaced (timescales of hundreds of seconds) and, thus, counts on the melt may provide a more accurate comparison to other non-impact surfaces.

New crater counts were compiled for the continuous ejecta around North Ray, South Ray and Cone Craters. Each of these craters has an absolute radiometric age determined from Apollo samples. The new counts are significantly different from those compiled by [10-11], probably because the LROC images are of high and more uniform resolution. Counts were made using LROC images with a scale of ∼0.5 m / pixel. The diameter and morphology of the craters indi-cate that they formed on the ejecta and are not on the underlying surface. Earlier counts used Apollo Pan and Lunar Orbiter images.

Cumulative size-frequency data determined with LROC images are greater by a factor of ∼3 to >10 from previous values [10-11], but are still below equilibrium values.

These new data indicate issues associated with using the youngest portions of the cratering chronology.

(1) The conclusion that the continuous ejecta blankets are significantly contaminated by self-secondaries means that using those surfaces as tie points for the absolute chronology will in-troduce two types of errors. First, the flux rate will be over-estimated since a significant fraction of the craters are not part of a primary production population. Second, using the number of craters on the ejecta blanket will introduce errors when comparisons are made with non-impact surfaces (e.g., mare materials). Counts for mare surfaces of identical age to the con-tinuous ejecta of a crater will be lower and thus indicate a younger age. It does not appear that the number of self-secondaries is a constant for which a simple correction can be applied.
(2) Issues of self-secondaries aside, the tie points for North Ray and Cone Craters need to be adjusted to reflect the more accurate counts provided by the LROC images.

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