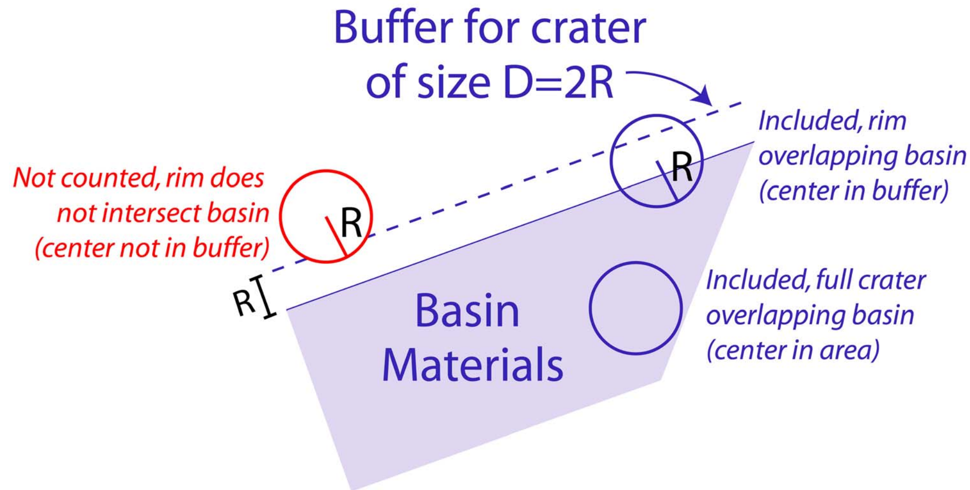

Figure 1. Schematic diagram illustrating the buffered crater-counting used to count craters to date basin deposits and thus ages. Areas are calculated independently for a given crater size, and craters are counted that post-date the basin and whose rims overlap basin materials [see also *Fassett and Head*, 2008, and references therein].

DTMs are available, but for our purposes (recognizing craters ≥20 km), minimizing the amount of interpolation in the DTM is desirable and the 64 ppd resolution is more than sufficient to recognize craters. For crater measurement we use the CraterTools extension to ArcMap [*Kneissl et al.*, 2011], which corrects diameter measurements to an appropriate local projection, and we compute all areas using an equal area map projection. The catalog of lunar craters reported on by *Head et al.* [2010] and *Kadish et al.* [2011] is available online at http://www.planetary.brown.edu/html_pages/LOLAcraters.html and detailed count data and areas are presented in the auxiliary material.[1]

2. Results

[12] The superposed crater densities for measured basins are given in Table 1, along with period assignments and inferred sequence. In Table 1, we provide N(20), and N(64) metrics for all the basins, as well as N(10) for these most sparsely cratered basins Schrödinger and Orientale where we made measurements to smaller crater sizes. These follow the standard convention that N(X) is the cumulative number of craters of size greater than or equal to diameter X normalized to an area of 10^6 km^2. This acts as a summary statistic with reference to a specific diameter, easing comparison between different measurements, although it is less detailed than the size-frequency distributions as a whole (available in the SOM). Because the measured distribution is a sparse sampling of the crater population, the N(20) density we give is extrapolated from the smallest sized crater greater than 20 km, and the N(64) density is interpolated from the density implied by the next largest and smallest craters. These corrections typically change the inferred N(X) value by less than ten percent from raw densities and are necessary to accurately compare basins. Example crater size-frequency distributions are reproduced in Figure 2.

[13] Two major observations are evident from the crater size-frequency distributions in Figure 2, the supporting online material, and Table 1. First, despite differences in technique and improvements in data necessary to identify craters (LOLA topography), our new period assignments and basin sequence are generally consistent with those derived by *Wilhelms* [1987]. There are some minor intraperiod differences in sequence, which are expected given that counting statistics lead to overlapping error bars for some basins. It should be pointed out that a number of sequence relationships are clearly provisional (e.g., Humorum and Crisium; Freundlich-Sharonov and Nectaris), as they are indistinguishable in age on the basis of crater statistics; additionally, the sequence relationships for basins marked in the table with brackets should also be considered more uncertain for the reasons given in Table 1.

[14] Second, while there is general agreement in the basin sequence, the quantitative densities and crater size-frequency distributions that we observe on these basins differ quite appreciably from Wilhelms's measurements (Figure 3). These differences are minor for Imbrium and Orientale, but grow systematically larger for older, Nectarian and Pre-Nectarian basins. This difference is likely to be attributable to the observational advantages of using topographic data to recognize superposed degraded craters, rather than image data, which is limited by uneven illumination geometries and varying resolutions.

[15] These quantitative differences in crater frequencies have implications for the broader understanding of the stratigraphy of the Moon, particularly with regard to the Pre-Nectarian/Nectarian boundary. Period assignment based on our crater counts that used frequencies from *Wilhelms* [1987] to establish period boundaries would underestimate the portion of the Moon that is Nectarian and overestimate the amount that is Pre-Nectarian. Our data show much higher

[1] Auxiliary materials are available with the HTML. doi:10.1029/2011JE003951.