CRATER SIZE-FREQUENCY DISTRIBUTION MEASUREMENTS AND AGE OF THE COMPTON-BELKOVICH VOLCANIC COMPLEX. K. A. Shirley¹, M. Zanetti¹, B. Jolliff¹, C. H. van der Bogert², and H. Hiesinger². ¹Dept. of Earth and Planetary Sciences & McDonnell Center for the Space Sciences, Washington University, One Brookings Drive, St. Louis, MO 63130; ²Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Germany.

Introduction: The Compton-Belkovich Volcanic Complex (CBVC), which is ~25×35 km in size and occurs at 99.8°E and 61.3°N on the Moon [1], is unusual in that the small-crater size frequency distribution (CSFD) of several flat areas within the complex suggest relatively recent resurfacing, e.g., <1 Ga [2]. Indeed, a cursory inspection of Lunar Reconnaissance Orbiter (LRO) Camera images suggests that the CBVC has a lower impact crater density relative to surrounding surfaces. In this abstract we report results of CSFD determinations over a larger scale, which incorporates a more significant number of relatively larger craters than our previous counts. These new counts support our previous finding that the larger crater population reflects an old age, ca. 3.6-3.8 Ga, whereas the smaller crater population is anomalous, perhaps reflecting target and/or regolith properties [3]. Degradation of volcanic features, such as the weathering down of dome and cone features, is also consistent with an origin > 3 Ga ago.

Methods: Crater counts were done using LRO Narrow Angle Camera (NAC; 0.5-2.5 m/pixel) and Wide Angle Camera (WAC; ~100 m/pixel) images [4] to estimate the age of surfaces at the CBVC. Crater counts were done on the regions of the CBVC that exhibit high reflectance and elevated topography (Fig. 1). A count was also done on a flat region outside and north of the CBVC for comparison. NAC images were resampled to 10 m/pixel for our large-area count such that only craters ~20 m or larger were counted. Counts were done using CraterTools [5] in ArcGIS and absolute model ages (AMAs) were fit using the chronology and production functions of [6] in the program CraterStats [7]. Two WAC count areas encompassed the high albedo area (802.5 km²) and the topographically elevated area (810.8 km²) of the CBVC. The first NAC count follows the overlap of the two WAC areas (554.5 km²) and includes 8757 craters. The NAC area was subdivided into four smaller areas (Fig. 1) to investigate variability, which was visible at a regional scale in the crater distributions. The CBVC NAC area excluded small areas presumed to contain secondary crater clusters, possibly originating from the Copernican crater Hayn [2]. A comparative NAC count was done outside of the CBVC to the north (39.6 km²).

Results: Our new WAC counts confirm the result we reported previously [2]; craters ranging from 600 m to 2 km in diameter are best fit by a 3.8 Ga isochron (Fig. 2A). Areas defined by topography and reflectance yield the same result. In these counts, we included all circular features, even if questionable as impact craters, thus we consider 3.8 Ga be an upper limit. However, excluding questionable craters still yields an age of 3.7 Ga.

The NAC counts have complex patterns; our summed NAC CSFD (Fig. 2B) has inflections at ~ 300 and 800 m crater diameters. The segment defined by craters >1 km can be fit by a 3.76 Ga isochron. An intermediate segment can be fit by a 3.2 Ga isochron. Craters smaller than 300 m are in equilibrium. When considering the subdivided areas separately (Fig. 2C & D), we see evidence for a range of ages ~400-800 Ma, defined by craters 100-200 m. The East and South count areas show an older age ~2 Ga, while the North and West count areas indicate a 3.2 Ga age. The Northern area outside of the CBVC is also complex, including segments with evidence for ages <1 Ga.

Discussion: The oldest AMA of ~3.8 Ga seen in both the NAC and WAC counts is most likely the youngest age of major resurfacing in the area due to one of the large, nearby craters, e.g., Belkovich (214 km diam.). Because this age is associated with the largest craters in the CBVC (>600 m), it may reflect in part the preservation of craters from before volcanism created the elevated CBVC topography. The younger age of ~3.2 Ga indicated by the intermediate segment of the NAC count for 400-700 m diameter craters might reflect partial resurfacing of small craters by the formation of Compton Crater (162 km diam.) or could be the age of CBVC volcanism.

CSFD segments defined by 100–200 m craters in small-area NAC counts [2] are best fit by <1 Ga isochrons. These data may reflect a young resurfacing
event (e.g., pyroclastic mantling associated with CBVC volcanism), indicate a small-crater retention age associated with material/regolith properties, and/or pyroclastic content of the regolith. The overall CBVC NAC count craters less than 300 m in diameter on the CSFD (Fig. 2B) closely parallel the equilibrium line, leading us to conclude that the AMAs indicated in the smaller area counts are more likely due to regolith properties.

The northern NAC count outside of the CBVC also shows the 3.8 Ga age, consistent with its location on the continuous ejecta of Belkovich Crater, if this is the age of Belkovich. There is no indication in this CSFD for a resurfacing age ~3.2 Ga. The smaller crater distributions, however, form segments in the CSFD that can be fit by <1 Ga isochrons, one at ~500 Ma age similar to the CBVC subsection counts. This result suggests that the <1 Ga AMAs are not unique to the CBVC and instead may have to do with surface properties or small recent impacts.

Conclusions: Considering all of the CSFDs, we have very different options for the age of CBVC activity: less than 1 billion years or greater than 3 billion. Volcanic features at the CBVC have morphologies that are qualitatively more consistent with a >3 Ga age. Taking into account the region outside of the CBVC, we find that the ~3.18 Ga AMA segment seen in the CBVC NAC counts suggests that this age is unique to the feature and possibly the age for the volcanic resurfacing of the CBVC. We infer that the volcanic activity occurred without destroying all of the large craters, thus an older surface age still shows through. We plan to continue research into the <1 Ga surface ages and the ages of the surrounding large craters for their role in local resurfacing and to further constrain the age of the CBVC.

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Figure 2. (A) CSFD’s and AMAs for all count areas. WAC count area defined by high reflectence is in black and the area defined by the topographic high in blue (B) The overall NAC count for CBVC. (B) The NAC subsections (as depicted in Fig. 1) for the North and West subsections (North count in green, West count in black). (D) NAC count subdivisions: East count in red, South count in blue.