CRATER SIZE-FREQUENCY DISTRIBUTION MEASUREMENTS AT THE COMPTON-BELKOVICH VOLCANIC COMPLEX. K. A. Shirley[1], M. Zanetti[1], B. Jolliff[1], C. H. van der Bogert[2], and H. Hiesinger[2] [1]Dept. of Earth and Planetary Sciences & McDonnell Center for the Space Sciences, Washington University, One Brookings Drive, St. Louis, MO 63130; [2]Institut für Planetologie, Westfälische Wilhelms-Universität Münster, Germany.

Introduction: The measurement of crater size-frequency distributions (CSFDs) is a commonly used method to date surfaces of terrestrial planetary bodies. By combining the CSFD with a production function (*e.g.*, [1]), we can estimate the age of the surface (absolute model age, AMA). Here we report the results of several counts performed in relatively flat areas in and near the Compton Belkovich Volcanic Complex [2] (CBVC), centered at ~99.8° E Lon, 61.3° N Lat. Motivation for this study is that visual inspection of Lunar Reconnaissance Orbiter (LRO) Camera images give an impression that this feature has relatively fewer impact craters than the surrounding terrain, suggesting perhaps a relatively young age for a lunar volcanic terrain.

Crater counts were done using LRO Narrow Angle Camera (NAC) and Wide angle Camera (WAC) images [3] to estimate the age of volcanic activity at the CBVC. Crater counts were done in two relatively flat regions on the north side of the CBVC, one on the west side in a broad, flat-bottomed irregular depression, and one south of the CBVC, outside of the topographic and reflectance boundaries that define the outline of the CBVC (Fig. 1a). We also counted craters on the continuous ejecta deposit of Hayn Crater (Copernican, 87 km diameter), which is located ~200 km northwest of the CBVC. Ray material from Hayn forms a prominent system of grooves, lineations and small secondary crater chains in the vicinity. (Fig. 1b).

Methods: Narrow Angle Camera (NAC) and Wide Angle Camera (WAC) (~ 100 m/pixel). Images were collected for Hayn Crater and the CBVC. Because of the huge number of craters resolved by the NAC, images were resampled to 5 m/pixel to allow for counting large areas. Counts were done using CraterTools [4] in ArcGIS and AMAs were fit using the production functions of [5] in the program CraterStats [6]. One large WAC count area and seven NAC count areas were selected at Compton Belkovich, six within the confines of the complex and a large area (area 7) outside for comparison (Fig. 1). At Hayn, two large WAC and two NAC count areas were selected on the continuous eject blanket (Fig. 2).

Results: NAC and WAC counts at the CBVC show evidence of resurfacing. At least four ages can be fit along the crater size-frequency distribution (CSFD) (Fig. 3). In the NAC counts, the oldest age, defined by the largest counted craters, can be fit at ~3.6 Gy, which is similar to the 3.8 Gy age derived on our preliminary WAC count area (Fig. 1). A distinct kink occurs in the

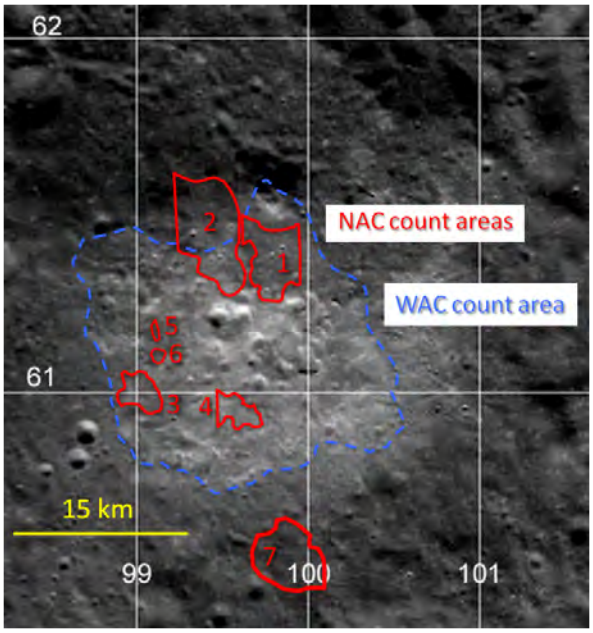

Figure 1. CBVC crater count locations, WAC basemap.

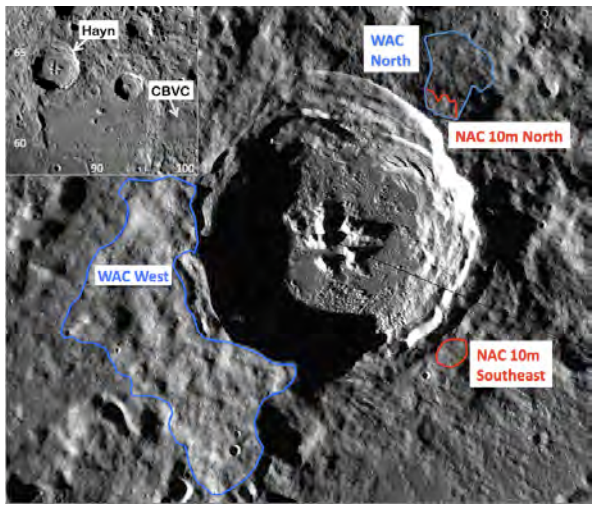

Figure 2. Hayn Crater Count areas, WAC basemap.

Compton Belkovich NAC curve at 848 Mya. Two very young ages at 262 My and 63 My are also seen in the curve and discussed below. CSFDs derived for other count areas reflect some of these same general characteristics. A count area to the south of the CBVC (CSFD not shown) does not reflect the younger age kinks and is distinctly different from CSFDs for count areas within the CBVC. At Hayn Crater, the absolute model

age (AMA) based on NAC counts of craters on the continuous ejecta yields an age of ~960 My.

Discussion: Within the CBVC, we note the relative paucity of small craters (*e.g.*, 5-100 m), and the CSFDs for areas within the CBVC have kinked patterns (*e.g.*, Fig. 3). We do not yet understand the cause of kinks in the CSFDs, and we suspect that the youngest model ages for our count areas (< 100 My) reflected in the distribution of 5-40 m diameter craters may correspond to a small-crater retention age that could be specific to materials, regolith properties, and/or pyroclastic contents of regolith. However, the paucity of craters in the 40-100 m diameter range suggests that a resurfacing event occurred sometime in the past 1 billion years. The CBVC counts tend to show an intermediate AMA "step" of several hundred My, most commonly around 260 My. We do not see this AMA step recorded in counts outside of the CBVC.

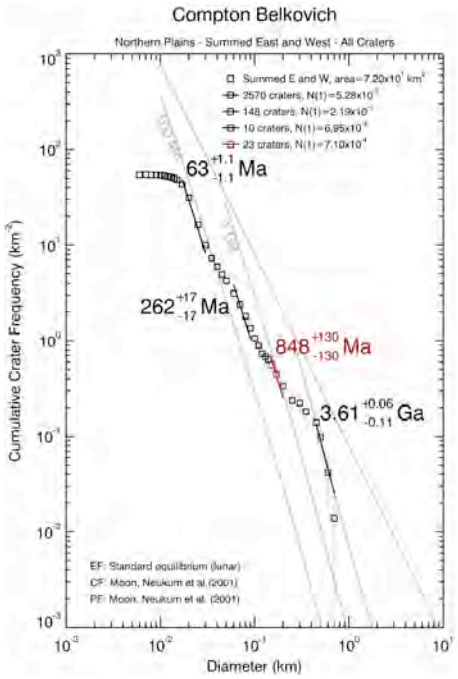

Figure 3. CSFD constructed by summing NAC count areas 1 and 2 on the north side of the CBVC (Fig. 1).

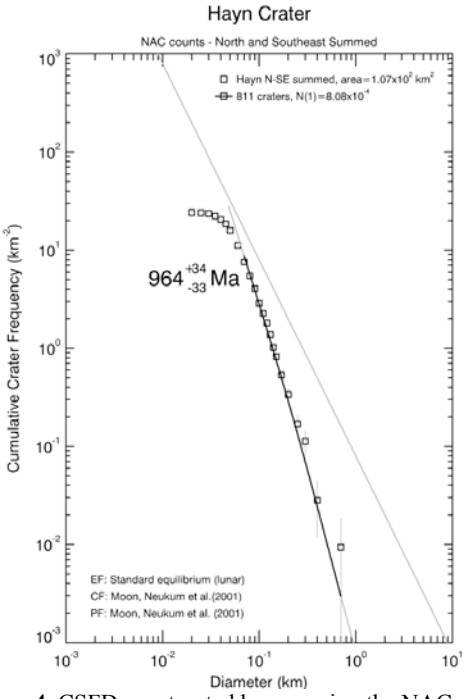

Figure 4. CSFD constructed by summing the NAC count areas for Hayn Crater continuous ejecta deposits (Fig. 2).

Hayn Crater may provide an important constraint. The Hayn counts (NAC) reflect a Copernican AMA of ~ 960 My. We observe small crossing secondary crater chains on the NE and SW extents of the CBVC, but no obvious sculpture or lineations related to Hayn in the central area. Still, the secondary chains are in locations and are of small enough sizes that we might expect them to have been reset by CBVC volcanism if it occurred after they formed. Accordingly, the CBVC would be older than Hayn.

Finally, in the large count areas containing craters >300 m, as in a preliminary CBVC WAC count and CBVC NAC Areas 1 and 2 (northern plains), we also see a >3 Gy step in the CSFDs. A simple interpretation is that this AMA reflects the resurfacing in this region associated with large craters and the end of the late-heavy bombardment. This is important for the CBVC because it suggests that at least some of the large craters within the CBVC may be "relicts" that were present when the CBVC magma intruded and formed the initial, low dome topography.

At this point, we are left with a conundrum; did volcanism occur before or after 900 My, or both? Long-lived volcanism or multi-stage volcanism at the CBVC would require a long-lived heat source, which seems unlikely outside of the PKT. If the CBVC is old (> 1 By), what is the cause of the mid-Copernican segment of the CSFD? Further work is planned to address these issues.

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References: [1] Neukum G. & Ivanov B. A. (1994) In *Hazards Due to Comets and Asteroids* (T. Gehrels, ed.), pp. 359–416. [2] Jolliff B. L. et al. (2011) *Nature Geosci.* **4**, 566-571. [3] Robinson M. A. *et al.* (2010) *Space Science Reviews* **150**, 81-124. [4] Kneissl *et al.*, (2010) PSS, 10.1016/j.pss. 2010.03.015. [5] Neukum *et al.* (2001) *Space Sci. Review* **96**, 55-86 [6] Michael G. & Neukum G. (2010) *EPSL*, **294**, 223–229.