ARISTARCHUS CRATER: MAPPING OF IMPACT MELT AND ABSOLUTE AGE DETERMINATION.
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Introduction: Aristarchus Crater is a large (~40 km diameter), Copernican age, well-preserved impact crater, located within Oceanus Procellarum on the near side of the Moon (centered at 23.6°N; 47.5°W). Aristarchus is found in one of the most geologically diverse and intensely studied regions of the Moon. The crater is remarkable because it straddles the geologic boundary between the Aristarchus Plateau and surrounding mare flood basalts, and has presumably excavated material from both regions [1,2], and compositionally evolved non-mare rocks from the underlying crustal section. Using high resolution Lunar Reconnaissance Orbiter – Narrow Angle Camera (LROC-NAC) images, we are creating a detailed geologic and morphologic map of the crater and its surrounding proximal ejecta blanket. The high resolution of NAC frames (pixel scale: ~50 cm) allows us to examine the minute details of morphologic features, including impact melt flows and ponds. Mapping also allows us to determine the distribution and approximate volumes of these melt features, as well as provide morphologic comparison with spectral color variation. Here, we report on melt features observed during mapping. In addition, we derived absolute model ages (AMAs) using crater counts on the proximal ejecta blanket, crater floor, melt pools, and flow features to constrain the age of formation of the crater. These counts are also useful for investigating the effect of target material properties on the production of small craters.

Observations of Impact Melt Features: Impact melt features are ubiquitous in and around Aristarchus crater. Impact melts pooled along the large terraces of the crater walls and within the proximal ejecta blanket. Channels where impact melt presumably flowed are common and often connect ponds of melt. Almost all surfaces on the crater walls are coated with a thin veneer of impact melt. The melt veneer has flowed over the surface and in many places exhibits preserved flow lobes. Melts can also entrain large boulders, some of which appear to be stratified blocks of target material [see abstract #2262, this conference]. Impact melt also flooded areas of concentric ridges found around the outside of the crater rim, giving the area a smooth appearance. A distinct, voluminous, and extensive flow, can be found northwest of the crater rim (figure 1). The flow is large (~16.5 km²), smooth, and ends in a lobate scarp at its distal edge. This large flow feature appears to emanate from a series of theater-headed sources along the hummocky crater rim deposits, as well as being sourced from a network of channels from ponded melt at topographically higher positions on the rim. Originally observed in Lunar Orbiter V images [e.g., 1-3], higher resolution LROC images of this flow allow for more detailed investigation. The flow appears to have been quite low in viscosity, as it has flowed over a prominent ridge, and appears to have also mantled previous flow-like ejecta deposits. Shadow height measurements along its lobate terminus suggest that the thickness varies from 1 – 10 m, with the thickest parts closest to the source regions. Craters ~50 m in diameter have penetrated through the flow layer revealing underlying material. The flow contains many small fractures typical of impact melt pools and melt veneer. The fractures are most numerous where the flow is thinnest as it crosses the central ridge. The flow appears to have been mobile as it cooled as it exhibits a few small channels. Additionally, small craters, modified during flow emplacement, are observed within the flow.

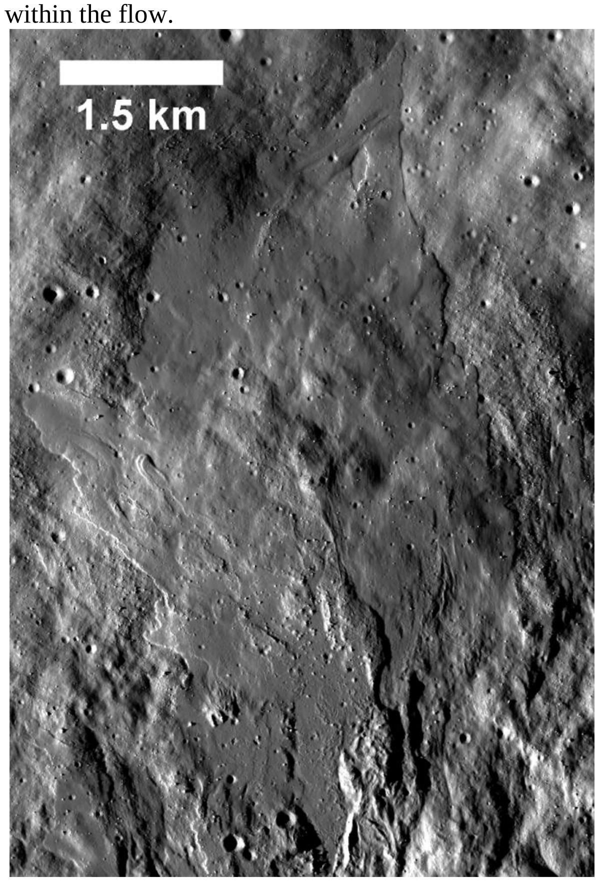

Figure 1: Large impact melt flow originating in hummocky ejecta NW of Aristarchus Crater. The flow

mantles ejecta, indicating it formed after the initial crater modification stage.

Absolute Model Age Determination: While Aristarchus has been intensely studied due to its unique geologic environment, the age of the crater is poorly constrained. Early estimates for the continuous ejecta blanket vary from ~1 Ga [e.g., 3, 4], to ~ 450 Ma [5]. These ages are based on relative crater densities, and the Hartmann [4] age is based on the data from Strom and Fielder [3]. An absolute model age for Aristarchus was determined by König et al. (1977), which suggested an age of 130 - 180 Ma [6, 7]. We performed crater counts on the proximal ejecta blanket on various homogeneous surfaces around Aristarchus, as well as on the floor of the crater, and impact melt pools inside and outside of the crater. Craters were counted using CraterTools [8] developed for ESRI ArcGIS and the data were plotted and fit using the statistics program CraterStats [9]. Absolute model ages were derived using the chronology and production functions from Neukum et al. 2001 [10]. This chronology is valid for lunar craters between 10 m and 100 m in diameter. Because of the high resolution of LROC NAC images, we are able to count craters as small as 2 meters. Our counts have covered ~33 km² of the ejecta blanket, yielding more than 20,000 craters with diameters ranging from 230 m to 2 km. Populations of obvious secondary craters were carefully avoided.

Our counts on the proximal ejecta blanket reveal an age of ~175 Ma (figure 2), which are in excellent agreement with the previous counts of König et al. 1977 [7]. Counts were also performed on areas of the crater floor, melt pools along the terrace walls, and melt pools on the ejecta blanket. The floor of Aristarchus is composed principally of impact melt, and has a ridged and ropy texture, containing many open fractures. This texture makes discerning impact craters, and determining accurate diameters difficult, resulting in an AMA of ~40 Ma, likely not representative of the true age of the crater. Counts performed on impact melt inside and outside of the crater yield ages of ~70 Ma. These areas give significantly younger AMAs, which may result from differences between the material properties of the melt and ejecta blanket, which influences the crater size-frequency distribution of these units [11]. These age discrepancies have also been noted in crater counts performed at Jackson, Tycho, and Copernicus craters [11, 12, 13]. The disagreement in ages between the melt pools and ejecta blanket needs to be investigated further, and counts on the floor and other impact melt pools are ongoing. However, if the properties of target material influence the crater size-frequency distributions, a volcanic interpretation for the melt pools is not necessary, as suggested by [3].

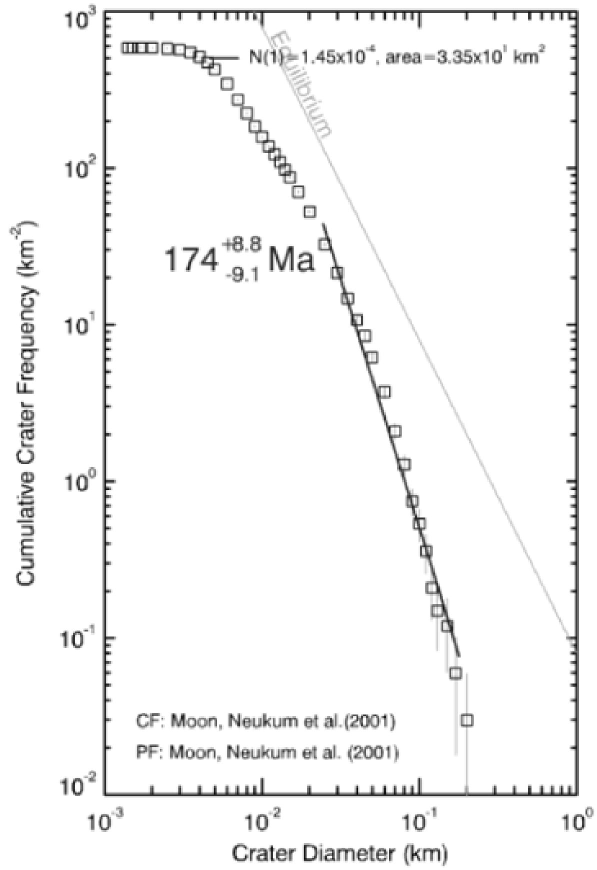

Figure 2: Crater size-frequency distribution for crater counts done on the proximal ejecta blanket of Aristarchus Crater. An absolute model age of ~175 Ma was determined. This age is in good agreement with previous AMAs [6,7].

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