CHARACTERIZING MOULTON CRATER AND ITS IMMEDIATE SURROUNDINGS.

Mohini. J. Jodhpurkar[1], Lillian R. Ostrach[2], and Nicolle E. B. Zellner[3] [1]Arizona State University, Tempe, AZ 85282 mjodhpur@asu.edu. [2]USGS Astrogeology Science Center, Flagstaff, AZ 86001. [3]Albion College, Albion, MI 49224

Introduction: Moulton crater (~50 km in diameter, 61.1° S, 97.2° E) is impossible to study from Earth-based facilities because it is in the Moon's southern hemisphere, on the lunar farside. However, the Lunar Reconnaissance Orbiter Camera (LROC) has systematically imaged the Moon with its Wide Angle Camera (WAC) and Narrow Angle Cameras (NAC), enabling photogeologic mapping of this region [1].

With NASA's recent focus on the lunar farside and areas around the Moon's South Pole, Moulton crater is worth studying in greater detail to understand how it fits into the broader context of the region, as it contains a record of the intersection of several geologic processes. Moulton crater is situated between Mare Australe, a large but poorly understood expanse of lunar highlands, and Schrödinger basin (316 km diameter) – an impact crater so large that Vallis Schrödinger, a 375 km long linear valley thought to have formed by the impact itself, terminates at the rim of Moulton crater [2]. Moulton's immediate surroundings also include Chamberlin crater (58 km diameter) to the north, and its crater rim is slightly degraded to the east where it superposes the rim of Moulton H (44 km diameter). While we do not have samples known to originate from that region, crater counting provides the means to derive an absolute model age, eliminating the need to rely solely on other methods of relative dating, such as crosscutting relationships [3]. Absolute model age estimates rely on comparing crater density in this area to established crater models, which in turn hinges on samples collected from elsewhere on the Moon, and is currently the best way to estimate ages remotely, as is necessary for this study [4].

Moulton crater warrants further study, both because of the interaction of volcanic and impact processes recorded within it and because of its place in the broader context of its surroundings on the lunar surface.

Methods: This investigation relied on Lunar Orbiter Laser Altimeter (LOLA) and LROC WAC and NAC to characterize regional topography and morphology, while Clementine Ultraviolet-Visible (UVVIS) data informed us of composition. With the WAC imagery to give broader context for the region, the Clementine data were used to identify compositional units within Moulton crater. Then, a few NAC images that fell within the Moulton mare unit were identified, and an area within those images was selected for crater counting. Crater counting was conducted using the ArcGIS add-in, CraterTools [5]. Based on previous research, the threshold diameter for the NAC scale count was set at 10 m, while the WAC scale one was set at 500 m [6].

After crater counting, the information from the WAC, NAC, LOLA, and Clementine data in this region was used to delineate geologic contacts within the map area. The units derived from this process were given brief descriptions, relying primarily on morphologies and interpretations of composition.

Results and Discussion: A basic geologic map with compositional and morphological interpretations was created by refining the boundaries visible in the WAC imagery using NAC imagery and attempting to identify more detailed geologic features (Fig 1). Clementine UVVIS data also provided compositional data to help with identifying contacts between different units in this geologic map. Though in this effort it was difficult to derive a complete stratigraphy for the crater, the law of superposition suggests that the highland unit may be the oldest one, with the mare unit infilling the crater. The small lava flows are probably more recent additions, with the large secondary chain of craters indicating an even more recent event.

NAC-scale crater counting of the mare unit infilling Moulton crater yielded 2,820 craters greater than 10 m in diameter. Much of the crater size-frequency distribution (CSFD) plot is fit to the 3.6 Ga isochron, suggesting it is a useful estimate of age of this mare unit. By contrast, the WAC-scale count of Moulton and its surroundings yielded approximately 640 craters greater than 500 m in diameter. This plot was fit best with the 3.93 Ga isochron, supporting the interpretation that the highlands generally are older than the mare (Fig 2).

Future Work: A portion of Vallis Schrödinger appears to superpose Moulton crater, so future work will focus on exploring whether there are other compositional and geomorphological signs that suggest this relationship. Confirming this would further constrain Moulton's age in lunar history. Additionally, more crater counting will be conducted to compare the age of the mare unit within Moulton crater to that of Chamberlin and Moulton H craters, along with a portion of the Moulton crater floor outside of the mare unit to compare ages within the crater itself.

References: [1] Mazarico, E., et al. (2018) *PSS*, 162, 2-19. [2] Kramer, G.Y., et al. (2013) *Icarus* 233, 131-148. [3] Michael, G. & Neukum, G. (2010) *EPSL,* 294, 223-229. [4] Fasset, C. I. (2016) *JGR,* 121, 1900-1926. [5] Kneissl, T., et al. (2011) *PSS,* 59, 1243-1254. [6] Robbins, S. J., et al. (2014) *Icarus,* 234, 109-131.

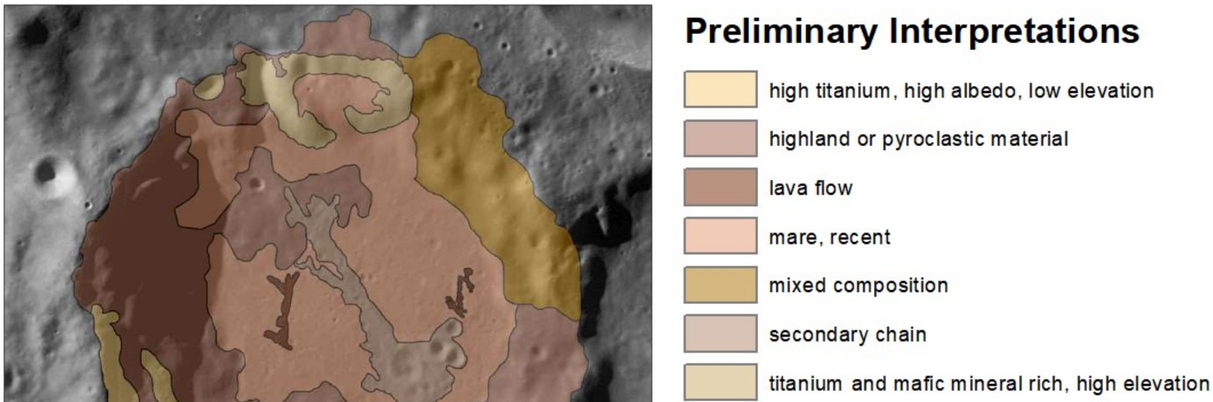

Figure 1: Preliminary map of Moulton crater, created by using WAC imagery to draw initial boundaries and then refining contacts using NAC imagery and Clementine UVVIS data.

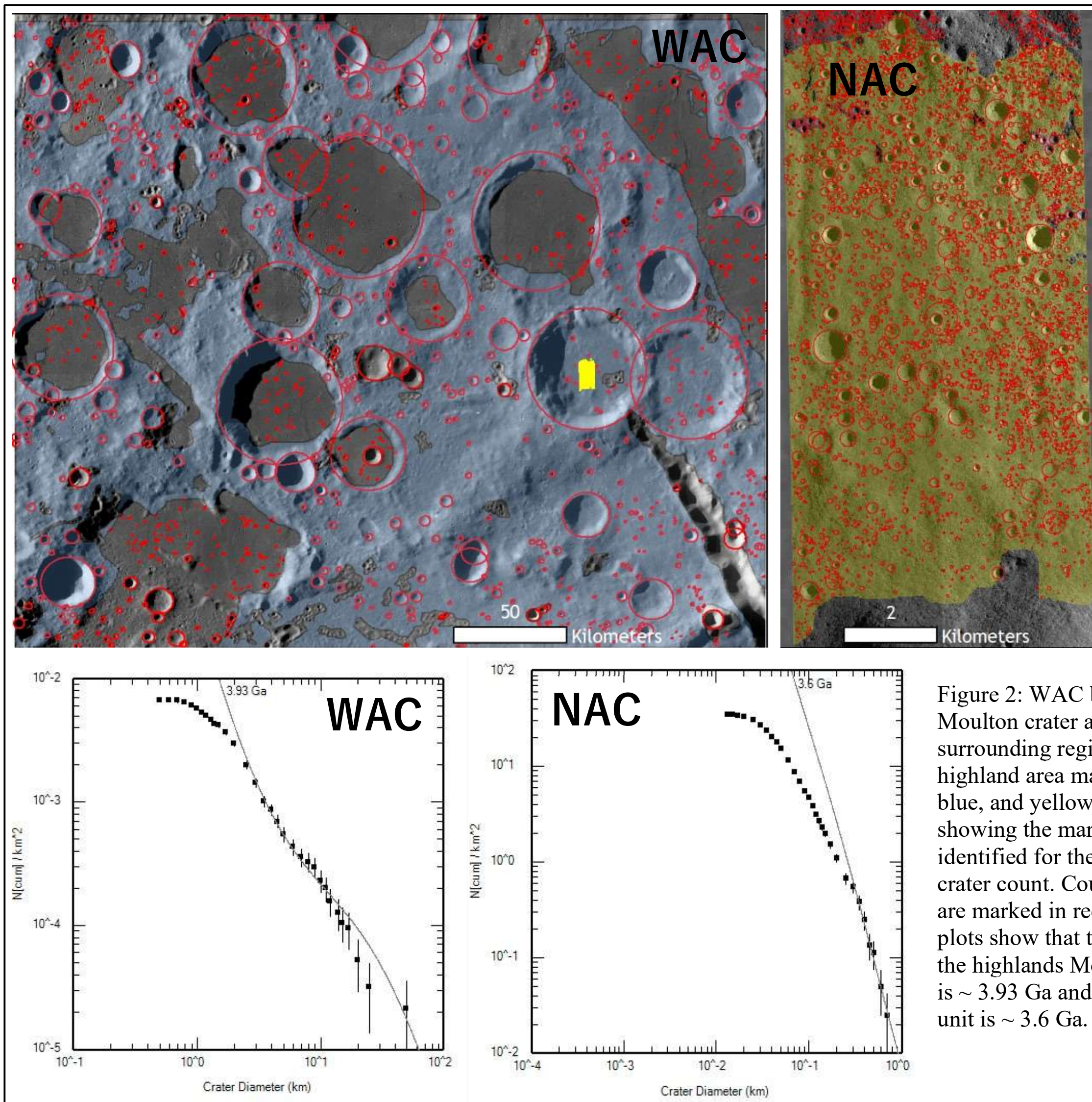

Figure 2: WAC basemap of Moulton crater and surrounding region, with highland area marked in blue, and yellow box showing the mare region identified for the NAC crater count. Counted craters are marked in red. CSFD plots show that the age of the highlands Moulton is in is ~ 3.93 Ga and the mare unit is ~ 3.6 Ga.