ROCKY EJECTA BLANKETS OF THE LUNAR MARE. M. A. Chertok[1,2], P. G. Lucey[2], and E. S. Costello[1,2], University of Hawai'i at Manoa, [2]Hawai'i Institute of Geophysics and Planetology (mchertok@hawaii.edu).

Introduction: The lunar regolith is formed by the bombardment of meteorites which pulverize the lunar surface forming a layer of fragmental debris. Regions of thinner regolith are expected to be rockier because smaller impactors are able to penetrate the regolith and excavate bedrock. As the regolith matures and thickens, fewer rocks are expelled.

The large age differences among some mare units offers a controlled opportunity for understanding the effect of impact exposure on the rockiness of the surface owing to the similarity of the substrate. In this study, we compare the very young Chang'e 5 (CE-5) landing site to the much older and more impacted Mare Humorum [1, 2]. Crater counts at CE-5 suggest this surface has undergone ~2.5-4 times less impact exposure than typical 3.5 Ga mare surfaces like Humorum [1].

In this work we report on the analysis of cumulative size-frequency distributions of rocky craters collected from CE-5 and Humorum. Our analysis features these controls: 1) substrate is limited to a single type (mare), 2) the regolith is thin enough such that all craters we can resolve in the study areas penetrate to bedrock and have the capability of ejecting rocks, and 3) the surfaces differ widely in reported impact exposure time.

Study Area: The CE-5 study area is in the Oceanus Procellarum, which includes the CE-5 landing site (centered on 42.795N, 52.095W) and the second study area is in Mare Humorum (centered on 22.812S, 40.166W). Each study site is 60x60 km (3600 km^2). The model age of this region of Humorum was reported as 3.45 Ga [1] and the CE-5 site was estimated to be 1.21-2.07 Ga [3-7].

Data: We use shaded relief imagery generated from the merged LOLA/Terrain camera DEM data set for the crater counting [8] and rock abundance is quantified using thermal inertia data from LRO Diviner following Bandfield et al. (2011) [9].

Methods: All craters counted are larger than 200m in diameter, which ensures the impactors penetrated to bedrock. Secondary impacts are included in the counts to capture the entire crater population, as this study did not intend to determine absolute model ages for the study areas. Rock abundance is quantified as the average values of the ejecta from the crater rim to one crater radius from the rim. Cumulative size-frequency distributions are measured for the total crater population in each study area, and also each of 10 percentiles of ejecta rock abundance. To more directly compare the mare study areas with one another, 90th percentile parameter minima for Humorum are applied to the CE-5 study area cumulative size-frequency distribution.

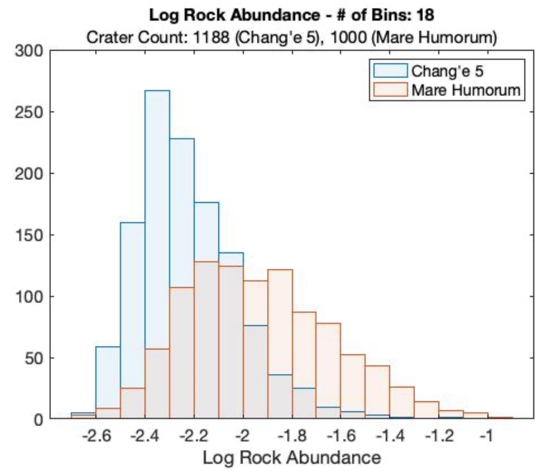

Figure 1: Log Histogram of CE-5 and Humorum ejecta rock abundance distribution.

Results and Discussion: We computed log-space histograms (Figure 1) and cumulative size-frequency distributions for the rockiest craters in the CE-5 and Humorum study areas. The shift in distributions between Humorum and CE-5 show that, contrary to expectation, impacts on the older Humorum surface are much more productive at excavating rocks than the younger CE-5 surface. This is also confirmed by the cumulative size-frequency distributions where only 6 CE-5 craters were equally as rocky as the 100 (90th percentile) rockiest craters in Humorum. Two hypotheses may explain this result: The original mare surfaces may have protoliths that developed mechanical differences during emplacement [10], or somewhat older surfaces are more fragmented making it easier for less energetic impactors to expel rocks.

Future Work: We plan to expand our crater counts to include many more ages using units defined by Hiesinger et al. (2001, 2003) [1, 3]. Ultimately, more data is needed to separate age from protolith.

References: [1] Hiesinger et al. (2000), *JGR*, 105(E12)., [2] Qian, Xiao, & Head et al. (2021), *EPSL*, 555, 116702., [3] Hiesinger et al. (2003), *JGR Planets*, 108(E7)., [4] Hiesinger et al. (2011), *GSA Spec. Prs.*, 477, 1-51., [5] Morota et al. (2011), *EPSL*, 302, 255-266., [6] Jia et al., (2020), *EPSL*, 541, 116272., [7] Wu et al. (2018), *JGR*, 123(E12)., [8] Barker et al. (2016), *Icarus*, 273, 346-355., [9] Bandfield et al. (2011), *JGR.*, 116(E12)., [10] Head & Wilson (2020), *Geophys. Res. Letters,* 47(20).