ROCK DISTRIBUTIONS AROUND FRESH IMPACT CRATERS AT THE INSIGHT LANDING SITE IN ELYSIUM PLANITIA, MARS.

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Introduction: The InSight (Interior Exploration using Seismic Investigations, Geodesy and Heat Transport) mission is scheduled for launch in May 2018 and will land in western Elysium Planitia in November 2018 [1]. The landing site is comprised of relatively flat Hesperian plains with scattered impact craters. The presence of rocks surrounding impact craters may be used to assess relative age of impacts in combination with other morphologic characteristics such as infilling, interior eolian bedforms, rim degradation, superposition of smaller impact craters, and extent and continuity of the ejecta blanket [2]. Craters in the region with diameters >200 m exhibit rocky ejecta, whereas smaller craters have progressively fewer rocks due to excavation into only an upper few meters thick layer of fine-grained regolith and not penetration to the deeper coherent basaltic lava flows. The distribution of rocks around craters is not expected to be uniform; proximal ejecta tends to contain larger and more abundant rocks versus distal ejecta [3]. Here, we quantify the radial decrease of rock abundance away from crater rims.

Data and Methods: We use rock cumulative fractional area (CFA) maps and visible image mosaics produced by Golombek *et al*. [1]. Rocks in the maps were detected by supervised automated detection of their shadows [4,5] in ~0.25 cm/pixel High Resolution Imagining Science Experiment (HiRISE) images [6]. Small rocks are more abundant than large rocks but occupy less area, such that the cumulative size-frequency distribution of rocks follows an exponential function that can be used to predict the abundance of unresolved smaller rocks [4,5]. For the InSight landing site maps, detected rock size-frequency distributions between 1.5-2.25 m in diameter were fit to CFA exponential models [1]. We used these CFA values and visible HiRISE images to select 120 impact craters that show elevated rock abundances extending outwards from crater rims by at least 1 crater radius (Fig. 1). For each crater, we perform a least squares fit to a power law similar to [3] $CFA(\%) = k \cdot r^{-1/\tau}$, where r is the crater radius, k is the CFA at the rim, and τ describes the distribution of rocks (proximally clustered rocks have low τ, and a more even distribution has high τ).

Results: Rock CFAs at 119 of the 120 selected impact craters exhibited a radially decreasing trend of CFA (Fig. 2), while only 1 crater exhibited an on-average increasing trend that was due to interference by a larger nearby larger impact. Selected craters range from 40 to 740 m in diameter and have CFAs ranging as high as 36% to as low as 5-10% where few rocks were detected. Curve fit values for k correspond to the mean CFA at crater rims (up to 36%), while curve fit values for τ range from 0.8 to 3.4 in describing more clustered and more even distributions of rocks, resp. (Fig. 3).

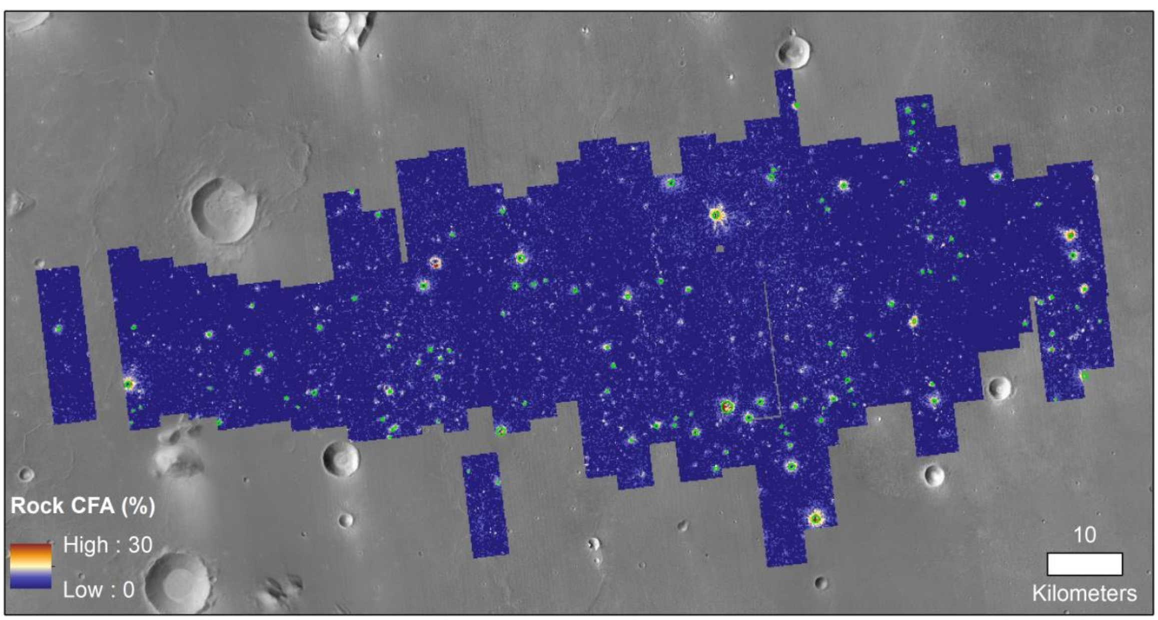

Figure 1. Rock CFA across the InSight landing site, modified from [1]. Craters used in our study are circled in green.

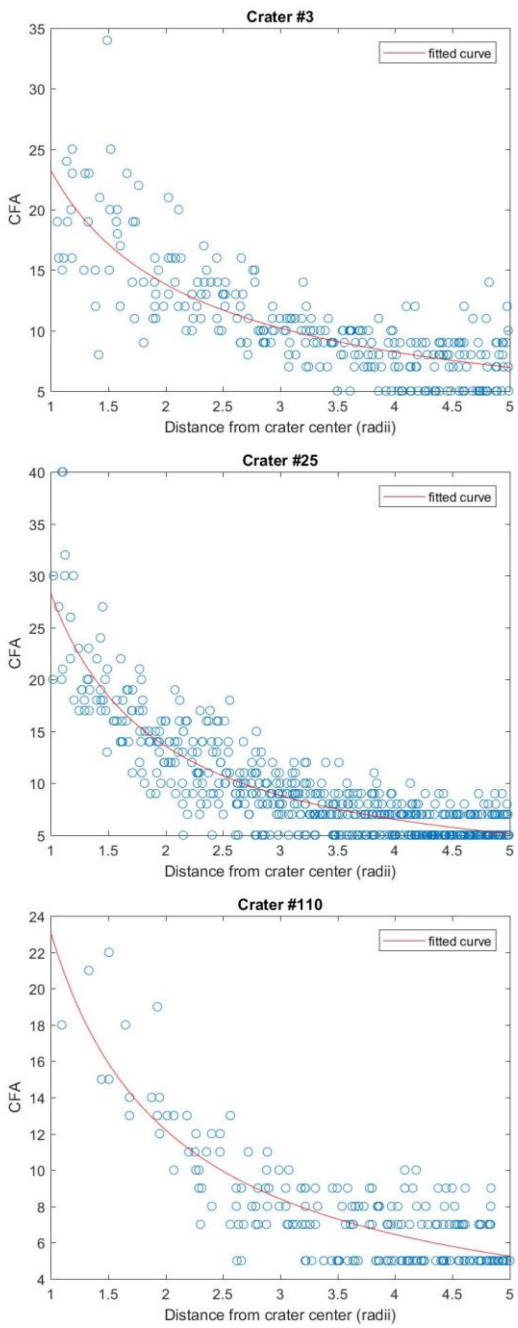

Fig. 2: Rock CFAs plotted radially outwards from 3 example craters and fit with power law fits. Rocks are more abundant proximally to crater rims than more distally.

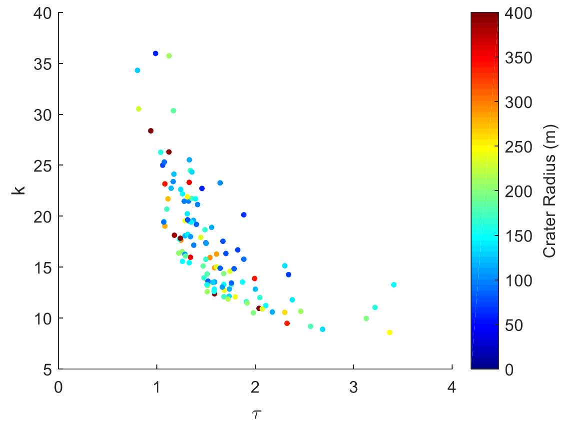

Fig. 3: Summary of power law fit coefficients k and τ, color-coded by crater radius.

Discussion: Overall across all crater sizes, k and τ are inversely correlated as one might expect with craters that have many rocks near their rims (high-k) also having more rocks distributed outwards (low-τ). Crater radius does not appear to necessarily limit the potential for high rock abundance near impacts, as small craters that have rocks exhibit a wide range of k and τ values. Although [2] found that many small craters did not have rocky ejecta, likely due to excavation in relatively thick regolith at those locations, the small craters that do have rocks fill the parameter space for both magnitude of abundance k and radial distribution τ. We suggest that for craters of relatively similar size, the combination of low-k and high-τ may be used as a proxy for greater relative age. Future work will compare our results for each crater versus other morphologic degradation indicators discussed by [2]. We will also examine the distances and sizes of individual detected rocks for each crater in addition to the cumulative area presented here. We will also compare the largest detected rocks for each crater to model estimates for largest rocks as a function of crater size and total ejected mass for these Martian craters.

References: [1] Golombek M. P. et al. (2017) Space Sci. Rev. 211, 5-95. [2] Warner N. H. et al. (2017) Space Sci. Rev. 211, 147-190. [3] Bart G. D. and Melosh H. J. (2010) Icarus 209, 337-357. [4] Golombek M. P. et al. (2008) JGR 113, E00A09. [5] Golombek M. P. et al. (2012) Mars 7, 1-22. [6] McEwen A. S. et al. (2007) JGR 112, E05S02.