CONTRIBUTION OF INDIVIDUAL BLAST ZONE FEATURES TO MARTIAN SURFACE ALBEDO CHANGES. A. E. Etgen[1], G. D. Bart[1], and I. J. Daubar[2], [1]University of Idaho, Department of Physics, 875 Perimeter Dr. MS 0903, Moscow, ID 83844-0903, USA, [2]Brown University, Department of Earth, Environmental and Planetary Sciences, 324 Brook St. Box 1846, Providence, RI 02912, USA.

Introduction: Impact cratering is generally assumed to be a spatially random process across the Martian surface. However, the distribution of the newly formed date-constrained craters that have been detected from orbit is not random [1]. This non-random crater distribution is due to several factors, including uneven repeat imaging coverage and varying detectability of new craters depending on the surface characteristics at that location on Mars [2; Daubar et al. abstract, LPSC 2022]. Our goal is to better understand why we are detecting some new impacts and not others, so that we will be able to improve the estimate of the current impact cratering rate at Mars. Additionally, we hope to better understand surface modification processes involved with current cratering. To these ends, we have analyzed several of the major feature types that cause surface albedo change around the impact site. These features create a "blast zone" that is much larger than the crater [3]. It is this large blast zone that allows for the detection of fresh impacts by wide-angle imagery. By understanding which features most contribute to the blast zone, we will be better able to de-bias the new-impact observations.

Method: We estimated the contribution to surficial albedo change from individual blast zone features for 1203 relatively new craters catalogued by [4, see also Daubar et. al. abstract, LPSC 2022.]. Before and after images showing new impact sites were taken with a variety of instruments, including Context camera (CTX) and other orbital imagers. After detection, the sites were imaged with the High Resolution Imaging Science Experiment (HiRISE) to provide high resolution (25 cm/pixel in most cases) pictures of the craters and their blast zone features.

The surface albedo change caused by impacts is contained within the blast zone of a crater. We considered four major groups of distinct types of features: ejecta blanket/rays, halos, wind streaks, and landslides. These features have a variety of formation mechanisms, including atmospheric shockwave-surface interaction, ejecta deposition, and aeolian processes [3, 5, 6, 7]. These features can be darker or lighter than the surrounding terrain, and blast zones can contain a mixture of different types and relative albedos of features.

We identified these features in each of the images as follows: Ejecta blankets [Fig. 1a] are continuous albedo features with defined edges that typically extend out to 1-2 crater radii from the crater rim [8], and may break up into rays [Fig. 1b] towards the outer boundary. These rays are thin linear features that extend radially outward from the crater. They typically have well-defined boundaries, but fade toward their outer end [9]. Halos [Fig. 1c] are quasi-circular, albedo features with diffuse edges that surround the crater. They can extend out to hundreds of crater diameters from the crater rim. They are typically radially symmetrical, and gradually fade into the background albedo farther from the crater [3]. Wind streaks [Fig. 1e] have a single direction in each image. They fade toward their terminus, and can have poorly-defined edges. Finally, landslides [Fig. 1d] are well defined streaks that appear on small slopes, and are actually thought to be dust avalanches triggered by the impact air blast [5]. Individual landslides tend to occur on the meter to tens of meters scale [5] and as such are generally only resolved in sufficiently high resolution

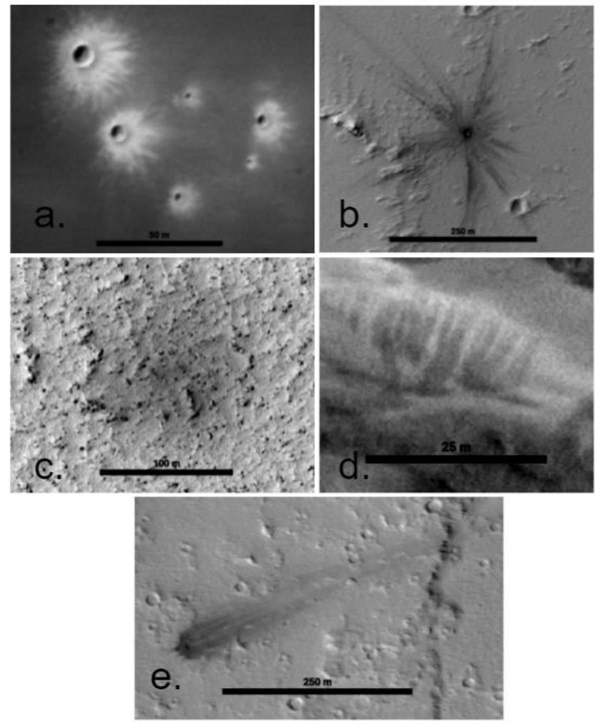

Fig. 1. HiRISE images where different blast zone features dominate the overall albedo difference. A: light blast zone in an impact cluster (ESP_044655_1730), B: linear rays from a single impact (ESP_018731_1770), C: a halo surrounding a single impact (ESP_033543_1845), D: landslides a small distance away from the impact site (PSP_005666_1790), and E: asymmetrical streaks from a single impact (ESP_050128_2025). Image credit NASA/JPL/University of Arizona.

images. Under ideal conditions, they occur in great numbers around the impact, and can contribute significantly to the blast zone albedo change.

Blast zones were viewed in full resolution HiRISE red channel images using the HiView software program developed by the HiRISE team at U of Arizona (https://www.uahirise.org/hiview/). Image contrast was stretched in order to optimize our observation of the blast zone features.

For each image, we first considered whether each of the features described were present. For each feature that was present, we then estimated by eye to the nearest 10% what fraction of the total albedo change was due to that feature. This was a very rough estimate, with significant error (±10-20%) but still should be sufficient for understanding large-scale trends; the difference between 10%, 50%, and 90% is robust. The sum of contributions from different types of features to albedo change for each image equaled 100%.

Results: First we report how frequently each of the different feature types occur at the new impact sites. The most common blast zone feature type identified at the 1203 fresh impact sites are ejecta blankets and rays, which were observed at 865 sites (72%). The next most common were halos (591 sites, 49%), wind streaks (288 sites, 24%), and finally landslides (82 sites, 7%). Our criteria for definition of "halo" (see Methods) is more constrained than that used by [4], resulting in a significantly lower halo count than they obtained.

Discussion and Conclusions: As seen in Fig. 2, when halos occur, they typically contribute a large amount to the total blast zone albedo change. Meanwhile, ejecta blankets follow a similar pattern to rays, typically contributing ~60% or less to the total blast zone albedo change when they occur. Finally, wind streaks and landslides tend to contribute less than half of the total albedo change when they occur, which is much less frequently than the other aforementioned features.

By roughly estimating the contribution of each feature in a large sample size of sites, we plan to investigate any trends that may correlate to surface characteristics and therefore shed light on formation mechanisms and their requirements. By understanding which features contribute the most to the blast zone, we will be better able to de-bias the new-impact observations, and derive a more accurate current impact cratering rate.

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References: [1] Daubar I. J. et al. (2014) LPSC abs. 1007 [2] Daubar I. J. (2013) *Icarus*, *225*, 506-516. [3] Bart G. D. (2019) *Icarus, 328,* 45-57. [4] Daubar et. al. (2022) *JGR* submitted [5] Burleigh K. J. (2012) *Icarus, 217,* 194-201. [6] Cohen-Zada A. L. (2016) *Aeolian Research, 20,* 108-125. [7] Daubar I. J. et al. (2016) *Icarus, 267,* 86-105. [8] Melosh H.J. (1989) Impact Cratering: A geologic process, Oxford University Press, 89-90 pp. [9] Sabuwala T., et al. (2018) *Phys. Rev. Lett.*, *120*, 264501.

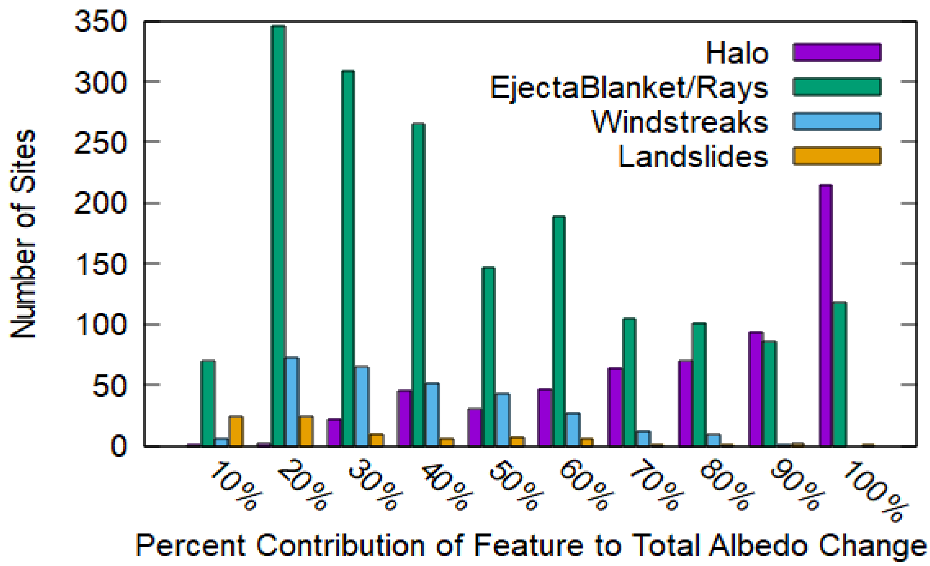

Fig. 2. Clustered histogram showing number of detections that contribute a certain amount to the total albedo change of the entire blast zone for the five most common blast zone features. Ejecta blankets and rays were grouped together due to their propensity to occur together.