SHAPE, ROUNDNESS AND TEXTURE OF PARTICLES ALONG THE SPIRIT ROVER TRAVERSE FROM SOL 750 TO SOL 1824. R. A. Yingst[1], L.S. Crumpler[2], R. Li[3], P. de Souza[4], and the Athena Science Team, [1]Planetary Science Institute (1700 E. Fort Lowell, Suite 106, Tucson, AZ 85719; yingst@psi.edu), [2]New Mexico Museum of Natural History and Science, Albuquerque, NM, [3]The Ohio State University, Columbus, OH, [4]Tas ICT Centre, CSIRO, Hobart, Australia.

Introduction: The transport, sorting and abrasive processes that have altered the loose surface particles comprising a sedimentary population are best recorded in the morphologic characteristics of those particles [1-3]. These morphologic characteristics can provide an important comparative datapoint when attempting to deconvolve the geologic history of a location. Additionally, because many morphologic characteristics can be described numerically [3,4], they yield a quantitative metric for categorizing and comparing particles using other numerical values such as spectral signature [5-7]. Here we report on morphologic characteristics (size, shape, roundness, texture) of surface particles in Gusev Crater imaged along the path of the Spirit rover from sols 750 to 1824, in the vicinity of the structure informally known as "Home Plate." Our goal is to use these data to better constrain the boundaries of potential geologic units associated with "Home Plate."

Geologic Setting: "Home Plate" is a polygonal exposure of layered outcrop in Gusev Crater, <1 to 2 m-tall and approximately 80 m diameter. Stratigraphic units at "Home Plate" include a lower, laminated, coarse-grained "Barnhill" unit and an upper, cross-bedded, finer-grained "Rogan" unit [8-11]. Ringing the structure and overlying much of the local "Barnhill" unit is the rubbly "Discovery Valley" unit and to the southeast and southwest are regions classified as "Aeolian" [11], including the area associated with the target "Troy" (Arvidson et al., this volume).

"Home Plate" has alternately been interpreted as a base surge deposit resulting from a hydrovolcanic eruption [8, 12] and an impact surge deposit (e.g., [13]). Evidence for the former hypothesis includes the presence of spherical mm-scale clasts that may be accretionary lapilli, alternating coarse to fine-grained clastic sequences, high- to low-angle cross beds, and a conspicuous bomb sag that formed when a 3-cm diameter ballistic impacted deformable sediment. Additionally, "Home Plate" is basaltic and similar to nearby scoriaceous blocks, but with elevated volatile elements, including Cl, Br, Zn, and Ge, suggestive of a pyroclastic or hydrovolcanic origin [8, 12]. However, [13] noted that the coarse-grained layers at the base of "Home Plate" and the low-angle cross-bedding in general are widespread in known impact surge deposits.

Data Collection: To better systematize a study of the characteristics of loose particles in the pebble to cobble size range (2-256 mm [14]; also referred to as clasts or float) in the vicinity of "Home Plate," we utilized the "clast survey" images, comprising a systematic collection of single frame images taken with the Pancam instrument [15, 16] looking at an angle of 70° down from horizontal and generally 0° azimuth in the rover frame. From sols 750 to 1890, clast survey image pairs of filters L7 and R1 were taken on 43 sols (no clast survey images have been taken post-sol 1890 because the rover has not moved significantly since that time). We have completed a preliminary assessment of clast survey images taken from sol 750-1824.

Spirit's location for each sol was determined by [17] using triangulations utilizing landmarks in orbital and ground images, and checked by Doppler radio positioning. We utilized the methodology of [7] to calculate size, shape (sphericity, or how closely a particle profile resembles a sphere) and roundness (a measure of the sharpness of particle corners). Texture, or how a particle surface varies from a perfectly flat surface at scales smaller than the corners and angles of the particle, was classified qualitatively.

Results: The size, sphericity, elongation and textural characteristics of 464 particles determined to be loose, unburied surface particles were examined (200 particles were imaged at high enough resolution so that roundness could be determined).

Particle size and shape. A range of particle sizes is present, from below resolution to nearly 172 mm in major axis length, with the smallest measurable parti

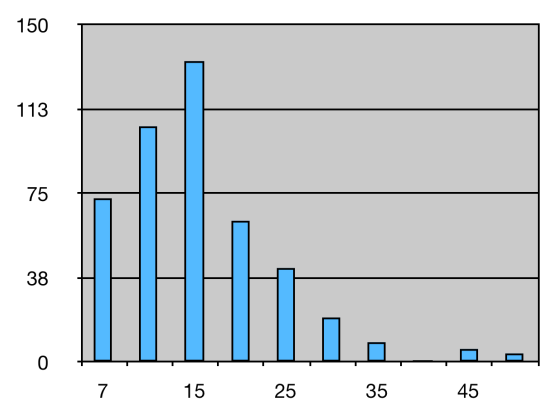

Figure 1. Histogram of particle size in mm (x-axis). Frequency is on the y-axis.

cle being 4 mm. All examined particles fall within the pebble to cobble size range; however, particles within the "Home Plate" region are somewhat larger than those imaged prior to reaching "Home Plate." The average clast size around "Home Plate" is ~14 mm, compared to 9-11 mm outside the region [7], and the largest clast (~172 mm) is sigificantly larger than the largest clast imaged prior to sol 750 (~70 mm).

The mean value for particle sphericity is 0.73 and the median is 0.75, with a maximum value of 0.89 and a minimum of 0.44. The mathematical average for sphericity is thus similar to particles outside the "Home Plate" region (0.72), but there is a tighter distribution of sphericity values for "Home Plate" particles than for particles imaged along the prior traverse. Rather than the broad distribution and multiple peaks interpreted to demonstrate a locational dependency shown by the sphericity values of [7], only one well-defined peak exists (Figure 2). This is consistent with the interpretation that only 2-3 highly interrelated geologic units are sampled here.

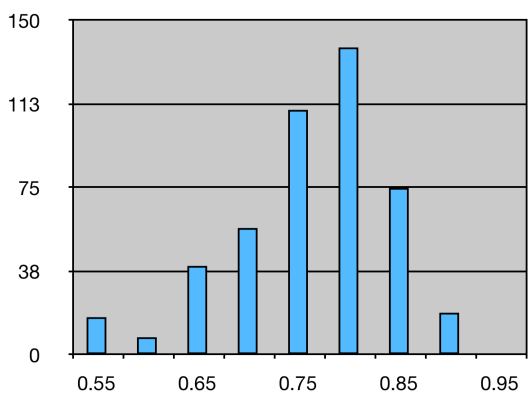

Figure 2. Histogram of particle sphericity values (x-axis). Frequency is on the y-axis.

Roundness. The roundness mean for the subset of particles for which this characteristic could be determined is 0.15, similar to values along the prior traverse. Nearly 60% of all roundness values range between 0.06-0.15. Most particles are classified sub-angular, as assessed utilizing [18]. Qualitatively, roundness ranged from very angular to well-rounded, but most particles were classed as sub-angular or sub-rounded.

Texture. Clast texture was categorized using the types outlined by [7]. Types 1 (vesicular), 2 (relatively flat facets ending in sharp to rounded edges) and 3 (similar to Type 2 but with rougher, more irregular edges) were present, though Type 4 was not. A texture that did not fit into any of these categories (referred to here as Type 5) displayed a rough, somewhat granular texture organized in horizontal layers. Type 1 appeared rarely, and occurred in larger (>20 mm diameter) particles that commonly overlaid both Type 5 clasts and a platy, layered basement material. Types 2 and 3 occurred in most images and were the most common textural types. Type 5 particles were limited to the "Home Plate" structure itself (the "Rogan" unit of [11]).

Discussion of comparison to mapped units: Four of the geologic units mapped by [10, 11] were sampled by the clast survey campaign; of these, clasts were imaged for three units: "Discovery Valley" (D), "Rogan" (R) and "Barnhill" (B). B paricles are characterized by a smaller than average size (13.25 mm with a maximum of 29 mm), a slightly higher sphericity and roundness (0.76 and 0.2) and a mix of Type 2 and 3 textures. D paricles are characterized by a slightly smaller than average size (13.32 mm with a maximum of 50.7 mm), average sphericity and lower than average roundness (0.73 and 0.12) and texture Types 1-3, with 2 and 3 dominating. R paricles are characterized by a larger than average size (14.92 mm with a maximum of 172 mm), a slightly higher sphericity and average roundness (0.74 and 0.15) and the presence of Type 5 textures mixed with Types 2 and 3 (and rarely Type 1). Differences in morphologic characteristics correlate well with mapped unit boundaries where such boundaries were imaged [10,11], though numerous boundaries were not imaged in the clast survey.

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