CLAST SIZES AND SHAPES AT THE INSIGHT LANDING SITE. C. M. Weitz[1], J. A. Grant[2], N. H. Warner[3], M. P. Golombek[4], S. A. Wilson[2], E. Hauber[5], V. Ansan[6], C. Charalambous[7], N. Williams[4], F. Calef[4], T. Pike[7], H. Lethcoe[4], J. Maki[4], A. DeMott[3], and M. Kopp[3]. [1]Planetary Science Institute, 1700 East Fort Lowell, Tucson, AZ, 85719 (weitz@psi.edu), [2]Center for Earth and Planetary Studies, National Air and Space Museum, Smithsonian Institution, 6th at Independence SW, Washington, DC, 20560, [3]SUNY Geneseo, Department of Geological Sciences, 1 College Circle, Geneseo, NY 14454, [4]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, [5]German Aerospace Center (DLR), Institute of Planetary Research, [6]University of Nantes, Laboratory of Planetary and Geodynamics, [7]Imperial College, London, Department of Electrical and Electronic Engineering.

Introduction: The Insight spacecraft successfully landed on Mars in the 'Homestead hollow' located in western Elysium Planitia [1]. After landing, images taken from both the ICC and IDC cameras [2] were used to determine the physical properties of the work volume around the lander in order to select a safe and benign area to deploy the seismometer (SEIS, [3]) and heat flow probe (HP3, [4]). The instruments had to be placed on a smooth, relatively flat, load-bearing surface with their feet placed firmly on the ground and with no rocks or relief greater than 3 cm [1].

In this study, we utilized the highest resolution IDC images taken between 0.5-1 mm per pixel spatial scale to measure the sizes of all clasts (here defined as loose pebble to cobble-sized rock fragments on the surface) larger than 2 mm (gravel size) in the work volume where the instruments could be deployed on the surface. We also measured the shapes of clasts greater than 2 cm in size using the 2 mm per pixel individual IDC images that covered a broad area south of the lander. Our results were used for selecting a safe area to deploy the SEIS and HP3 instruments, and can also provide important insight into the physical properties of clasts at a new landing site on Mars. Because there is no bedrock exposed at the landing site, the clasts reveal important clues regarding the geology of the area, especially the bedrock in the subsurface and the transport and erosional history affecting the region.

Observations: During landing, the spacecraft used thrusters to slow the descent. ICC and IDC images of the surface around the lander clearly show linear streaks emanating from the lander as a result of the jet plumes removing fine dust and smaller grains around the landing site, which is supported by orbital HiRISE images that show a blast zone surrounding the lander. Consequently, the landing site represents a disturbed surface rather than a pristine surface. Nevertheless, the clasts that are 2 mm and larger in size likely reflect the physical properties of clasts before the landing because the thruster jets could displace, but not completely remove, gravel size and larger clasts from the entire work volume.

Figure 1 shows the locations on the high resolution (0.5 mm/pixel) IDC mosaic for the placement of the SEIS and HP3. Within each of these instrument outlines, we measured all grains larger than 2 mm in size. We measured a total of 1965 grains in the SEIS location and 1288 grains in the HP3 location. The median grain size for the SEIS site is 3.7 mm with a range of 2-23 mm (Figure 2), and for the HP3 site the median size is 3.6 mm over a range of 2-17 mm (Figure 3). The dominant resolvable grain size at both instrument locations is 3-4 mm.

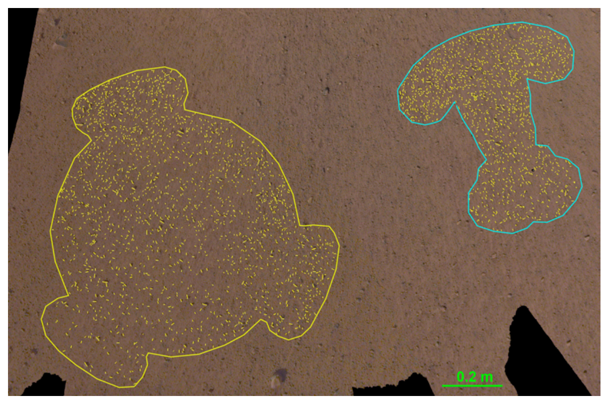

Figure 1. IDC high resolution mosaic of a portion of the work volume. The outlines of the SEIS (left) and HP3 (right) instruments with placement error uncertainties are noted. Within each instrument footprint, we measured the major axis for clasts larger than 2 mm in size, shown by yellow lines.

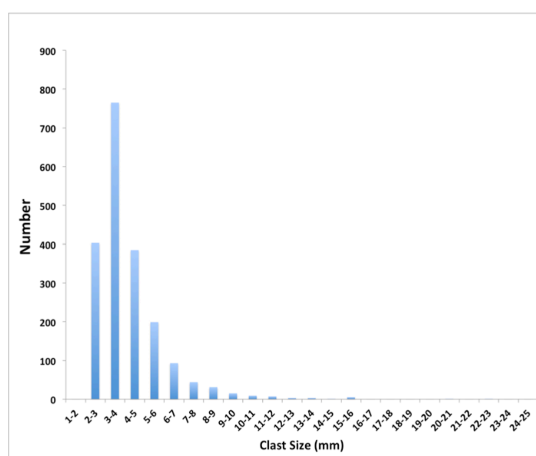

Figure 2. Grain size frequency for the SEIS workspace.

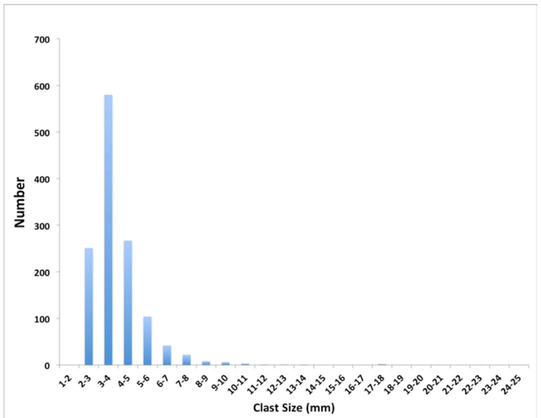

Figure 3. Grain size frequency for the HP3 workspace.

A 6.5 cm long cobble (Figure 4) was displaced ~0.5 m along the surface by the thruster jets. An erosional trail left on the surface by the dragging movement of this cobble indicates smaller cohesionless grains, most likely sand, are dispersed throughout the work volume but cannot be resolved. A similar rock displaced by the spacecraft thrusters was also observed at the Phoenix landing site [5] which used the same landing system.

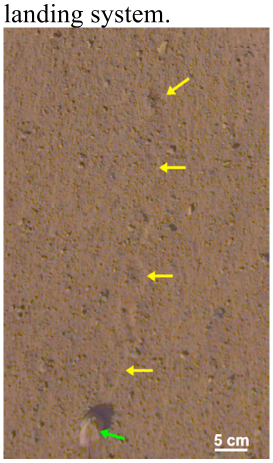

Figure 4. Portion of IDC high resolution mosaic showing a cobble (green arrow) that was displaced by the thruster jets along the surface to produce a trail (yellow arrows) in the sand. North and lander are at the top.

Shapes were measured for 118 clasts that were >2 cm in length and situated above the surface (i.e., not partially buried) in the IDC 2 mm individual images of the entire workspace. The aspect ratio (major axis divided by minor axis) was calculated and used to approximate the elongation of each clast. Figure 5 shows a plot of the aspect ratio as a function of clast major axis. Most clasts fall between 1.0-2.0 for aspect ratio (median 1.4), indicating minor to moderate elongation.

The angularity for pebble and cobble size clasts was estimated qualitatively using the comparative chart of [6] and ranges from sub-angular to sub-rounded, which is consistent with measurements for the Spirit and average Curiosity rover sites, but more rounded than the clast populations at the Viking and Mars Pathfinder sites [7].

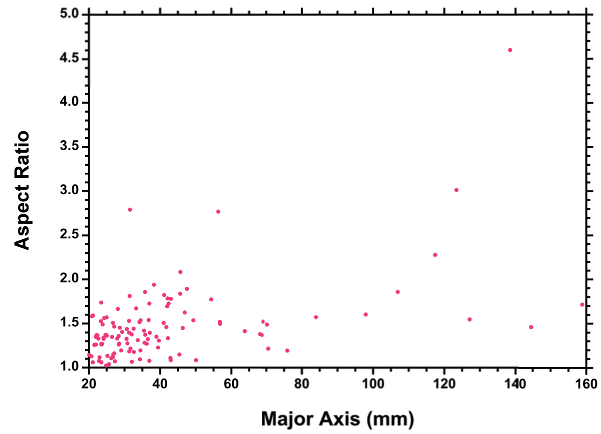

Figure 5. Plot of the aspect ratio as a function of clast length (major axis). Most clasts show minor to moderate elongation.

Discussion: Orbital data was used by [1] to calculate a thermal inertia of ~200 Jm-2K-1s-1/2, which is consistent with a surface composed of cohesionless sand size particles, some rocks, and thermally thin coatings of dust. The lander camera images and our measurements provide ground truth that confirms a surface dominated by sand grains (below the resolution of the IDC but inferred from dragging cobble, see Fig. 4) and 3-4 mm pebbles with a few larger cobbles and boulders interspersed in this regolith.

The size and shape of the clasts at the landing site are consistent with regolith and ejecta rocks expected in a hollow (circular soil-filled depression with a rocky rim inferred to be a former impact crater) on volcanic plains, like those at the Spirit landing site [8,9]. The clasts do not display vesicles, and rocks with fresher surfaces closer to the lander (presumably cleaned by the thruster jets) are black without vesicles, suggesting clasts at the landing site are impact ejecta fragments derived from aphanitic igneous rocks in the subsurface that have been partially rounded by eolian abrasion over time.

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