GRAIN-SHAPE ANALYSIS OF SAND AND SILT FROM PERIGLACIAL POLYGONAL PATTERNED GROUND LANDFORMS AT THE PHX LANDING SITE. J. E. Anderson[1] and M. A. Velbel[1,2], [1]Affiliation (include full mailing address and e-mail address if desired) for first author, [1]Michigan State University, Department of Earth and Environmental Sciences (East Lansing, MI 48824-1115; ande2077@msu.edu; velbel@msu.edu), [2]Smithsonian Institution, National Museum of Natural History, Division of Meteorites, Department of Mineral Sciences (Washington, DC, USA; VelbelM@si.edu).

Introduction, Background, and Previous Work: The Microscopy, Electrochemistry and Conductivity Analyzer (MECA) on Phoenix Mars Lander (PHX) included an Optical Microscope (OM) that returned color images of soil material with a spatial resolution of 4 μm/px [1]. The OM consists of a high-resolution fixed-focus, fixed-magnification optical imaging system and an active visible-light sample illumination system composed of four types of LED: [1]. The upper limiting grain-size imaged (200 μm) was determined by the sieve through which sample was introduced by the Phoenix Robotic Arm (RA) into the MECA instrument. The lower limiting size was determined by the 4 μm / pixel limit of the optical system [1]. Fine- and very- fine sand (200 - 62.5 μm) and all but the finest silt (62.5 - 4 μm) were imaged for eight samples from different periglacial polygonal patterned ground (PPPG) landforms within the Phoenix RA's workspace [2]. Previous research used color OM images to develop a taxonomy of soil particles classified by grain size and color from particle to particle; in order of decreasing abundance (in vol.%), red and white fines, brown sand, and black sand) [2,3], described their optical and magnetic properties [2,3], determined (together with measurements from the PHX Atomic Force Microscope (AFM; [1])) particle sizes and size distribution [4], compared grain form between PHX black and brown sands [5] and grain roundness among individual samples and trenches [6], and revised the photometric taxonomy of the brown grains [7].

Previous preliminary work [8] suggested that grains in the trough landform within the PHX RA workspace (Golden Goose sample from Stone Soup trench) had a distinctly lower roundness value than grains from samples at the top of the polygon (including Galloping Hessian from the Under Headless trench [8]. If differences are also observed in grain form in the Golden Goose sample (from the trough adjacent to the periglacial polygon), this would suggest some difference in grain accumulation, abrasion, fracturing, or aggregation in the trough grains relative to grains from the other PPPG landform settings examined [8].

Reanalysis of OM images of brown fine sand- and coarse silt-size particles in soils at the PHX landing site in terms of 3-point reflectance spectra (465 nm, 524 nm, 636 nm) reveals greater photometric diversity of brown sand than previously recognized - brown sand and silt grains at the PHX landing site can be subdivided into at least four groups based on photometric properties [7].

This presentation reports results of ongoing efforts to describe and interpret similarities and differences in grain shape (form) of PHX black and brown grains imaged by the OM among different PPPG landforms at the PHX landing site [6] and among different photometric groups [7].

Samples and Methods: Length (L) and width (W) were measured on 34 black and brown sand grains published in [2]. W, L, W/L are easy to standardize, easy to convert to measurements of both grain size and "shape" (in this presentation, L/W; aspect ratio, elongation), and are transferable among imager capabilities (none involve measuring any scale of "roughness" or surface textures of the grain envelope) [9].

Results: The range of grain sizes examined to date (Table 1) is similar to the larger number (~175 brown, 11 black) previously examined by [5]. The previously determined elongations (from the larger number of grains) extend to slightly larger values [5] than the present study.

Table 1. Elongation of PHX sand and silt

Sand-grain type		Black	Brown
Size	Max	190	120
Size	Min	40	22
Elongation	Max	1.9	2.3
Elongation	Min	1.0	1.0

Ongoing work: Future work includes but is not limited to quantitative image analysis of grain sizes and shape metrics.

References: [1] Hecht M. H. et al. (2008) *JGR, 113*, E00A22. [2] Goetz W. et al. (2010) *JGR, 115*, E00E22. [3] Goetz W. et al. (2009) *LPS XL*, Abstract #2425. [4] Pike W. T. et al. (2011) *GRL, 38*, L24201. [5] Goetz W. et al. (2010) *LPS XLI*, Abstract #2738. [6] Velbel M. A. et al. (2011) *LPS XLII*, Abstract #1516. [7] Velbel M. A. et al. (2022) *LPS LIII*, Abstract #1251. [8] Velbel M. A. et al. (2011) *LPS XLII*, Abstract #1516. [9] Weitz et al. (2018) *GRL, 45*, 9471-9479.