MAPPING OF SAND TYPES AND DUNE MORPHOLOGIES IN THE AEOLIS DORSA REGION, WESTERN MEDUSAE FOSSAE FORMATION, MARS. A. S. Boyd[1] and D. M. Burr[1], [1]Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN. (aboyd21@utk.edu)

Introduction: One of the great questions in Martian geology is the origin of sand, its temporal persistence on the Martian surface, and its deposition and transport mechanisms [e.g., 1]. Sand dunes occur globally on Mars [e.g., 2], and can provide clues regarding the source of dune sands via recording the direction from which sand is being transported [e.g., 3, 4]. Other aeolian deposits, as well as abrasional features like yardangs, can also provide clues in determining the sources of sand and its transport characteristics.

Numerous and pervasive aeolian features are located within the Medusae Fossae Formation (MFF), a laterally extensive sedimentary deposit just north of the highland-lowland boundary between the Tharsis and Elysium Mons regions [5,6]. The MFF is covered in many places by high-albedo dust or low-albedo sand, often in dunes. The Aeolis Dorsa (AD) region is located within the western MFF (wMFF) south of Elysium Mons. Aeolian, fluvial, and tectonic activity has shaped the morphology of this region; aeolian features in the AD include dunes, yardangs [7], and scour marks [cf., 8]. Discontinuous dark sand occurs both within and outside of yardang troughs, providing clues regarding variation in transport speeds and directions [9, 10]. Various sand deposits and surficial feature morphologies will be mapped and characterized to include as surficial deposit units for a funded map of the AD region.

This aeolian mapping effort is part of both the ongoing AD mapping project [11] and a newly funded effort to characterize the source(s) of sand in the wMFF. The determination of wind emplacement directions, localized wind speed variations, and of distributions of light and dark sand, will shed light on the source(s) of sand on Mars.

Background: The MFF covers 1.4 x 10^6 km^3, has an estimated volume of 1.4 x 10^6 km^3, and consists of layered deposits of fine-grained, light-colored material [5, 6]. Surface textures and features vary from smooth, thick deposits on the eastern side of the MFF to rougher, thinner deposits on the west side, which includes the AD study area.

MFF crater counts on the highly abraded surface date much of the surface to the middle Amazonian [12], but as the MFF records substantial post-depositional reworking [13], crater counts at lower elevations have dated the emplacement of regions within the unit to the late- to mid- Hesperian [13]. This extensive post-depositional reworking of the MFF complicates interpretation of its formation. Although the formation of the MFF is unresolved, lines of evidence point toward a volcaniclastic deposit of material from an explosive eruption [6], and more specifically as a hypothesized ignimbrite deposit [14]. Among these lines of evidence are that the MFF blankets underlying topography rather than being preferentially deposited in low-elevation areas and that it exhibits yardang morphologies consistent with yardangs formed in ignimbrites [6].

Volcanic and magmatic features surround the AD region. Elysium Mons lies to the north of the AD region and the Cerberus plains lavas bound its the northern and eastern sides; the Southern Highlands border the region to the south. Weathering of materials within each of these regions could generate significant amounts of dark sand that may have been subsequently transported to the AD region.

Hypotheses: The proximity of the AD region to Elysium Mons, the Cerberus plains, and the Southern Highlands allows for these three possible sources of sand; the interpretation that the MFF is volcaniclastic in origin provides a fourth possibility. Thus, our four hypotheses for the source(s) of sand in the AD region are: 1) in situ weathering of the MFF; 2) eruptive materials from Elysium Mons to the north; 3) comminution of Cerberus plains lavas to the northeast; 4) transport of preexisting sand from the Southern Highlands.

Data and methods: Our current preliminary work focuses on mapping aeolian deposits. The basemap for this project is comprised of images from the Context Camera [CTX; 15], which have a resolution of 6 m/pixel and cover almost the entire map area. Mapping on the CTX image mosaic will provide distributions of dark and dust-covered sand (Fig. 1), and, where higher-resolution data are unavailable, will be used to derive dune morphologies. Where they are available, we will use Mars Orbiter Camera [MOC; 16] narrow angle (NA) images, and High Resolution Imaging Science Experiment [HiRISE; 17] images for more precise morphology identification, as their respective resolutions of 2-20 m/px and 0.25 m/px allow for analysis of individual dune morphologies in high-dark bedform-density regions. Mapping will be conducted in ArcGIS, and sand deposits and dune morphologies will be recorded. Local wind directions will be inferred and mapped on the basis of dune and sand deposit morphologies, and used as input for the ArcGIS tool 'linear mean direction', which will provide a mean flow direction for the region.

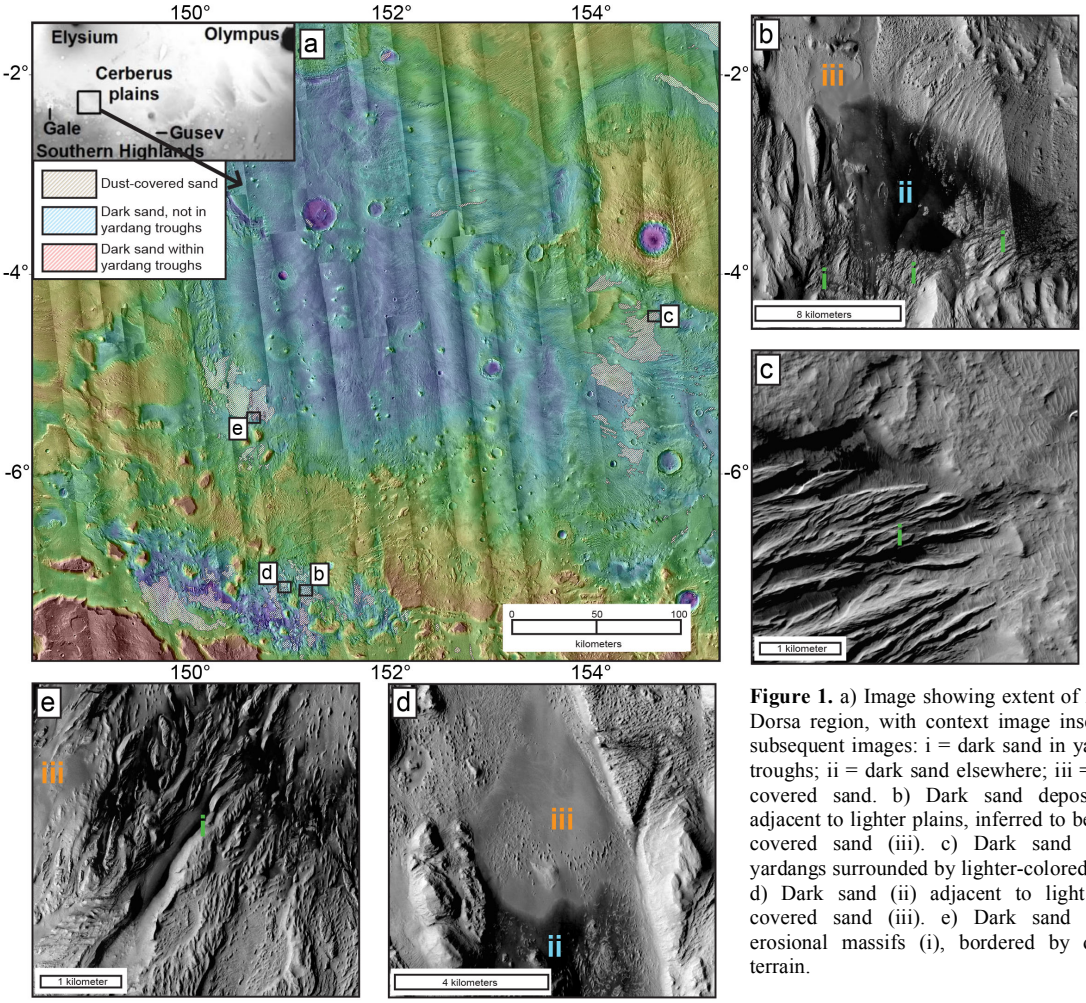

Figure 1. a) Image showing extent of Aeolis Dorsa region, with context image inset. All subsequent images: i = dark sand in yardang troughs; ii = dark sand elsewhere; iii = dust-covered sand. b) Dark sand deposit (ii) adjacent to lighter plains, inferred to be dust-covered sand (iii). c) Dark sand within yardangs surrounded by lighter-colored MFF. d) Dark sand (ii) adjacent to light dust-covered sand (iii). e) Dark sand within erosional massifs (i), bordered by dustier terrain.

Preliminary results: Preliminary mapping efforts highlight three distinct types of sand deposits: i) dark sand found within yardang troughs, ii) dark sand found outside of yardang troughs, and iii) light-colored (dust-covered) sand (Figs. 1b, d). Dark sand dominates the surface of a deep structural depression in the southwest corner of the study area (Fig. 1a). Yardangs with dark sand occur predominantly on the eastern side of the study area (Fig. 1c). Dust-covered sand plains exhibit scour marks indicative of underlying sand, as well as evidence for wind direction. Nearby dark sand, outcropping between erosional massifs, indicates funneling of wind (Fig. 1e). The south and southeast-facing sides of dunes and scoured features tend to be steeper than north- and northwest-facing sides of the same features. Dune slopes and scour marks both indicate dominant south-southeastward wind directions [cf., 8]. This result is consistent with sand source(s) from Elysium Mons, the Cerberus plains, and/or the wMFF itself.

Future work: High- and low-albedo sand deposits will continue to be mapped, and wind emplacement directions for dunes will be inferred based on morphology. Yardang morphologies will be mapped, and abrasion directions will be identified. Results of these mapping efforts will be combined with future spectroscopic analyses and atmospheric modeling to identify the source(s) of sand in the AD region of the MFF.

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