YARDANG DISTRIBUTION ACROSS MARS. C. M. Wagoner[1], K. D. Runyon[1]. [1]The Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Rd, Laurel, MD, USA, 20723, *Carlie.Wagoner@jhuapl.edu*, *Kirby.Runyon@jhuapl.edu*

Introduction: Yardangs are streamlined erosional landforms carved by wind-mobilized sand and/or soft sediment deflation by wind. They vary in size and shape based on the strength and azimuth of wind; substrate erodibility; entrained particle characteristics; and nearby topography [1]. These landforms often occur in groups and, given their superficial resemblance to ship hulls, they are often called "fleets" and occur in desert landscapes on both Earth and Mars; however, yardangs have possibly been observed on other planets such as Venus and Titan [1,2,3]. Continuous yardang fields on Earth can reach lengths of >100 km, such as those in Iran's Lut Desert. However, one of the most extensive fields of yardangs in the Solar System lies amongst the Medusae Fossae Formation of Mars [4,5].

The Medusae Fossae Formation (MFF) is a widely extensive geologic unit of probable volcaniclastic origin in the Martian tropics nestled on the equator between the southern highlands and northern lowlands [10]. It features an area of ~2.1 x 10^6 km^2 and a volume of ~1.4 x 10^6 km^3 [6]. While numerous hypotheses concerning the origin of the MFF have been proposed including paleopolar deposits [7], carbonate platforms [8], and aeolian mantling [9,10], the most robust theory of MFF formation involves a volcanically-sourced consolidated air fall ignimbrite of varying friability [10]. With the MFF being the largest source of dust on Mars combined with the irregularity of erodible deposits within it, the MFF provides an ideal location for yardang formation [11], though yardangs are not exclusive to the MFF.

Past projects have mapped the global distribution of aeolian dunes on Mars [12], and this project has similarly begun to map the locations of yardang fleets across Mars, starting near the MFF. In addition to mapping herd distribution, this project also classifies yardang morphologies divided into various types, with the four most common including u-trough, cat-scratch, teardrop, and anastomosing (Figure 1).

Methods: We mapped yardang groups using a global, uncontrolled mosaic [13] from the Context Camera (CTX) aboard the Mars Reconnaissance Orbiter. CTX operates in grayscale (in a visible light wavelength from 500-700 nm) at resolution of 6 m per pixel at an altitude of 300 km and a swath of 30 km wide [14].

Mapping was done in Java Mission-planning and Analysis for Remote Sensing (JMARS), a GIS system provided by ASU's Mars Space Flight Facility [15], at a pixel scale of 1024 pixels per degree (ppd). While yardangs smaller than this pixel scale exist, with some smaller yardangs visible at scales up to 16384 ppd, any undiscernible yardangs above 1024 ppd were not included. Additionally, while yardangs exist globally over Mars, this project limited its initial scope to around the MFF, which prominently features yardangs.

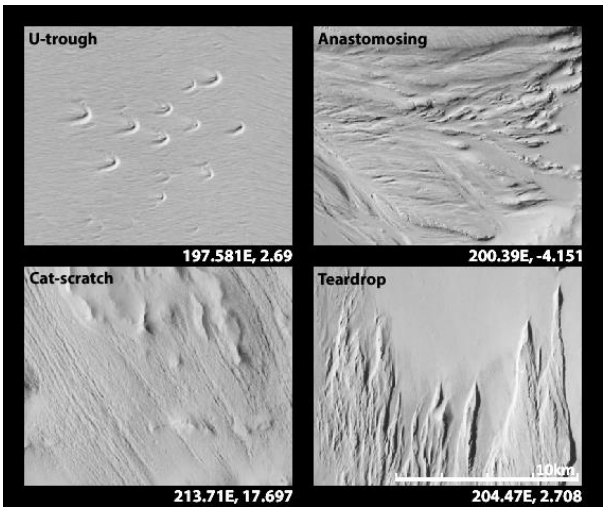

Figure 1: Examples of common yardang morphologies within the MFF. The bottom-right scale bar is 10 km long. All scales are at 1024ppd.

Results: The completed map of yardangs within the MFF is portrayed in Figure 2. Yardangs within this region (specifically between 130-240˚E, -20-30˚N) reach a combined area of ~1.2 x 10^6 km^2. Populations of yardangs extend from the northern to southern aureole deposit of Olympus Mons, hugging the mid-southern sections of Amazonis and Elysium planitiae. Additionally, these herds appear to be mostly—but not exclusively—confined to within the borders of the MFF, most notably the Aeolis, Zephyria, and Lucus plana, the Eumenides and Gordii dorsa and the Cerberus Fossae. Surrounding these groups are the volcanoes of Tharsis Montes to the east, Elysium Mons to the northwest, and Apollinaris Patera, nestled in the central-southern section of the MFF.

We divided yardangs into various types based on common morphologic patterns; u-trough, anastomosing, cat-scratch, and teardrop morphologies are pictured in Figure 1. U-trough yardangs are characterized by distinctive u-shaped moats upwind of an abutting butte.

Anastomosing yardangs are sub- parallel to each other with a braided morphology. Cat-scratch yardangs are closely-spaced, elongated, thin features parallel to one another. The most common type within the MFF is teardrop yardangs, which are elongated drop-shaped features with varying lengths and width, with notably wider aspect ratios than cat-scratch. They commonly terminate to a point at both ends and are parallel to wind direction. While teardrop yardangs often have a rounder shape facing the prevailing wind direction, both ends can be pointed in the shape of a diamond. Multiple morphologies commonly occur within one yardang herd in multiple locations across Mars. Other observed morphologies include curvilinear, bidirectional, scalloped, and serrated [16]. Because of the wide variety of yardangs, this project prioritized mapping the presence of any yardang group, regardless of individual shape, provided it was visible at a scale of 1024 ppd.

This project plans to expand the current map to include yardangs that lie outside of designated coordinates. Although not as prevalent, yardangs exist globally around Mars at all latitudes. Mapping these features at a global scale would provide greater insight in to how aeolian activity has shaped the Martian surface.

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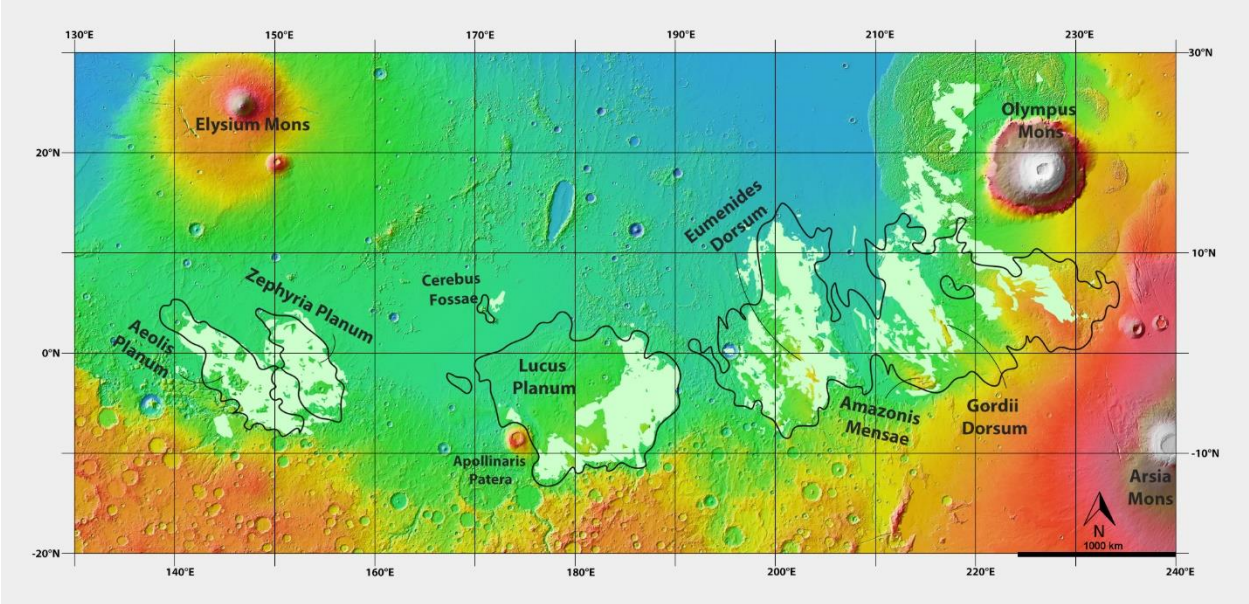

Figure 2: Map of yardang fields within 130- 240E and -20- 30N, with the colorized elevation version of the Mars Orbiter Laser Altimeter Shaded Relief as a basemap. Black outline represents regions associated with the MFF. Yardangs mapped in this project are in light green.