THE MEDUSAE FOSSAE FORMATION IN SW ELYSIUM PLANITIA, MARS AS A RECORD OF RECURRING HYDROGEOLOGIC ACTIVITY. K. Stacey[1], A. Khuller[2], and L. Kerber[3], [1]The University of Texas at Dallas, Richardson, TX 75080 (*kaitlyn.stacey@utdallas.edu), [2]Arizona State University, Tempe, AZ 85281, [3]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109.

Introduction: The Medusae Fossae Formation (MFF) is a voluminous, fine-grained deposit thought to be of pyroclastic origin [1-4] that has recorded a suite of landforms related to processes involving surface and subsurface H_2O. Some MFF deposits contain widespread, well-preserved inverted fluvial features [5-7]. The presence of long, complex, and sometimes overlapping branching fluvial networks imply multiple episodes of aqueous channel formation [5-9], potentially representing some of the best preserved sedimentary sequences on Mars [9]. However, their pervasive cover of dust means that little is known about their composition, and indirect means must be used to characterize their material properties and hydrogeological history [10]. This work aims to correlate fluvial features in the Western MFF [5-7] with other indicators of ancient hydrogeological activity: unique yardang morphology [11], volcanic rootless cones [12] and indications of persistent subsurface ice.

Methods: Context Camera (CTX) images were used to map features of fluvial origin (inverted channels, sinuous ridges, alluvial fans) in the Western MFF deposits. The locations and extent of rounded, meso-yardangs in proximity to these fluvial features were also mapped. Approximately 1400 fluvial segments were identified, with the most populous cluster located in Aeolis and Zephyria Plana. Rounded meso-yardangs were found to be common in areas that also have fluvial features. HiRISE images were used to identify and characterize over 1300 cratered cones, interpreted to be volcanic rootless cones, in Southwest Elysium Planitia. Where these cones were found in proximity to the contact between MFF and late-Amazonian volcanics, their locations were mapped.

Results: Rounded meso-yardangs, associated with salt-playa environments on Earth [13], were identified within Aeolis and Zephyria Plana, and provide additional evidence of liquid water on the surface of Mars (**Figs 1-2**). In addition, abundant cratered cones were identified in Southern Cerberus Palus and in the erosional trough north of Aeolis Planum, where young, Cerberus Fossae-derived lavas interacted with MFF materials from the Aeolis and Zephyria Plana. These cones are found on the flood lavas that abut the MFF border, embaying fleets of yardangs; and are found to preferentially form on top of and out of meso-yardangs overlain with lava. Due to their overall morphology and distribution, these cones are interpreted to most likely be rootless, hydrovolcanic features formed by explosive interactions between lava and volatiles present in the MFF substrate at the time of lava emplacement. The form and quantity of this water is currently unknown; possible hypotheses include subsurface ice lenses [14], regolith pore ice [15, 16], or hydrated minerals [17]. Additionally, remnants of unusual scalloped and pitted terrain is observed along some portions of the MFF margin in the Aeolis trough, proximal to rootless cone clusters. This terrain appears to have been exhumed from underneath the MFF by aeolian erosion and mantle degradation. Rootless cones are pervasive where this pitted terrain is found and their relationship is ambiguous; cones are often located interspersed with, or within, this terrain. The pitted terrain is reminiscent of sublimation-related thermokarst features [18] but could possibly be the result of the same lava-ice interactions that created the rootless cones.

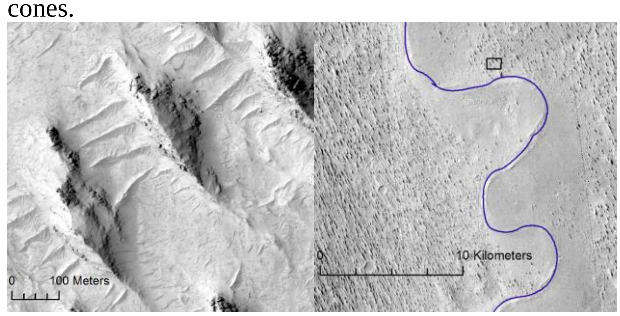
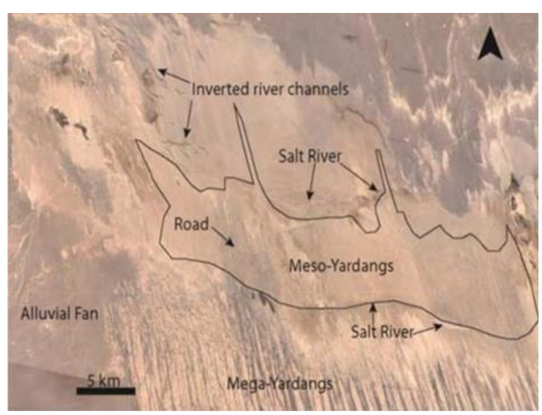


Figure 1. Left: A cluster of meso-yardangs seen in a portion of HiRISE image ESP_016414_1775_RED. **Right:** Context for meso-yardangs (black box) in close proximity to a fluvial feature (sinuous ridge, shown in blue) in a portion of HiRISE image ESP_016414_1775_RED.



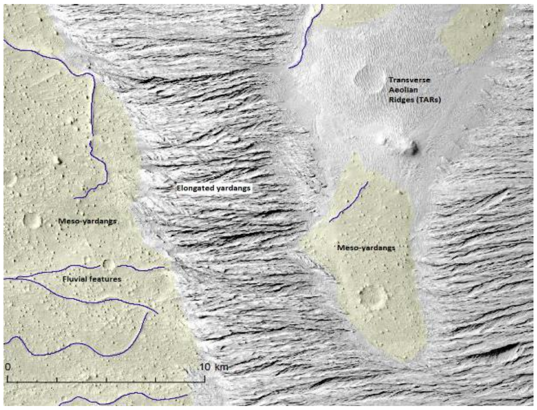


Figure 2. Top: Meso-yardangs found in the Lut desert, Iran, in close proximity to a salt playa. The meso-yardang area is characterized by salt rivers, salt polygons, and salt playa surfaces with wet mud below a hard, dry crust [12]. **Bottom:** The widespread presence of rounded, meso-yardangs (shaded yellow) amongst yardang fleets within and/or in close proximity of fluvial activity (traced in blue) underlines the correlation between fluvial activity and meso-yardang formation.

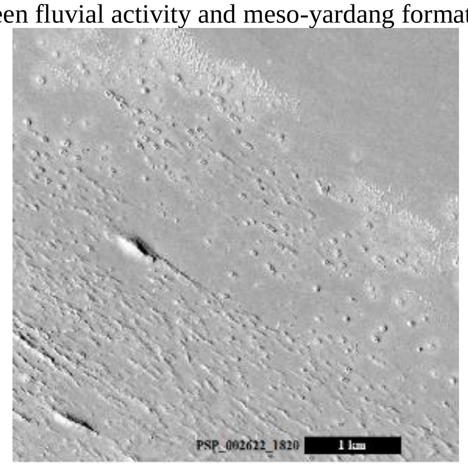


Figure 3. Rootless cones found in SW Elysium Planitia, bordering the MFF in the Aeolis trough. The upper right area of the image shows the meso-yardangs that have been covered with lava, and the rootless cones that have formed out of these yardangs.

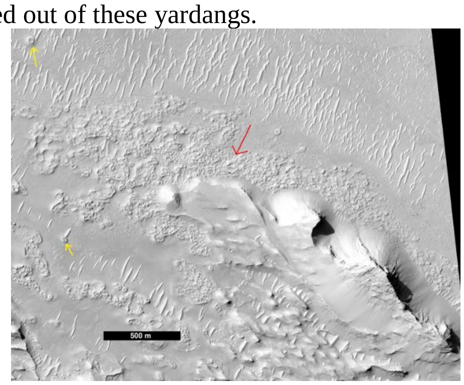


Figure 4. Example of possible remnant thermokarst terrain (red arrow), where the MFF is embayed by younger lavas. The pitted, scalloped surface appears to be exhumed from underneath the eroding meso-yardang. Examples of rootless cones are marked by yellow arrows. HiRISE image PSP_009808_1810.

Discussion: The preservation of fluvial activity through burial and exhumation, as well as the 'protection' provided by the emplacement of layers of fine-grained, friable MFF deposits, indicates that some of the most well- preserved stratigraphy can be accessed via surface exploration missions of this formation. Evidence recorded within the MFF should serve as a critical component in theoretical arguments regarding H_2O (either liquid water or ice) surface activity in Martian history. Indications of ice in the subsurface of Aeolis and Zephyria Plana (present in the form of volcanic rootless cones) suggests that the role of H_2O in shaping the surface of equatorial Mars might be understated. Indirect morphological indicators of water presence, such as rootless cones and rounded mesoyardangs, can be used in conjunction with valley networks and hydrated mineral signatures to obtain a more complete picture of the role of water in the shaping of the Martian surface.

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