THE DEEPEST BASIN ON MARS IS FORMED BY AEOLIAN EROSION: WESTERN HELLAS PLANITIA. A. D. Howard[1], A. Spiga[2], and J. M. Moore[3], [1]Department of Environmental Sciences, University of Virginia, Charlottesville, VA 22904-4123, ah6p@virginia.edu, [2]Laboratoire de Météorologie Dynamique (LMD), Université Pierre et Marie Curie, Paris, France, aymeric.spiga@upmc.fr, [3]NASA Ames Research Center, MS 245-3, Moffett Field, CA 94035, jeff.moore@nasa.gov .

Introduction: The western floor of Hellas Planitia features a deep annular trough (abbreviated here *HPT*) which, in the NW quadrant, at about -7500 m, averages about 1 km lower than the central Hellas Basin plateau (Fig. 1). We present evidence that this trough is strongly eroded by, and probably created by, persistent strong winds [*1-3*].

Meteorological Analysis: The Hellas basin, and particularly western and northern portions of Hellas Planitia is the dustiest location on Mars. Dust storms are frequent within western Hellas [*4*], and GCM modeling suggest strong winds within the *HPT* region and net long-term export of dust [*5, 6*], although some simulations suggest stronger winds over the Hellas rim than within the basin [*7*]. The great relief and steep regional slopes of the Hellas basin can result in strong katabatic windflow, particularly at the southern margin of the basin when CO_2 ice cover is present [*8*], leading to dust storm generation [*6*]. We employ the LMD Martian mesoscale model (MMM) [*9-11*] to explore the atmospheric circulation and surface stresses occurring within the Hellas basin. We make use of 3 embedded simulation domains ('nests") ranging from a large regional context resolved through 63 km square grid cells (Fig. 2) to a local simulation of the NW rim and floor of Hellas with 7 km grid cells (Figs. 3&4). We simulate the winds at Ls 133.8° (late southern winter), when a partial CO_2 ice cover is present on the southern rim and induces a thermal circulation which adds to the katabatic component (Fig. 2). Fig. 3 shows that this circulation extends towards the NW rim region, in which local slope wind circulation also takes place in the vicinity of rims (anabatic in Fig. 2 shown at 1 pm local time). Maximum diurnal shear velocities reach about 1.3 m/s in this region (Fig. 4). Minimum threshold shear velocities of ~1.0 m/s occur for 100 micron quartz particles (S_s=2.65), 10 mb atmospheric pressure and surface temperatures of 150°K (close to that of CO_2 frost) and at ~1.3 m/s for 240°K [*12*]. Thus simulated winds within Hellas basin are marginally capable of initiating sand transport. Given wind gustiness, seasonal variations in atmospheric circulation, and longer-term variations in obliquity and atmospheric pressure, it is likely that wind speeds capable of causing saltation have been common within the *HPT* since evaporation of the lakes that once occupied Hellas [*3*, *13*]. Athough the threshold speed for silt and finer sediment (likely components of the floor deposits) are greater than that of fine sand, sand saltation is effective at entraining fine sediment [*14*]. The high wind speeds in dust devils are also effective in entraining sediment, and dust devils and their tracks have been observed on Hellas Planitia [*15*, *16*].

Maximum simulated wind velocities and shear stresses are modeled near the break in slope between the *HPT* and the steep basin rim rather than along the deepest part of the *HPT* about 200 km to the SE adjacent to the Alpheus Colles Plateau. If wind erosion is responsible for sculpting the *HPT*, either the simulation misplaces the high velocity wind core, or most erosion occurs at a different season or obliquity, or the honecomb terrain is more erodible than deposits close to the basin edge.

Geological Observations: The floor of the *HPT* trough of NW Hellas Planitia exposes the enigmatic honeycomb (abbreviated *HT*) and reticulate deposits as well as undifferentiated plains material [*1*, *3*, *13*, *17*]. These deposits have been variously interpreted as volcanic, aeolian, and lacustrine in origin [*2, 3*, *18*]. The *HT* and parts of the undifferentiated plains units are complexly deformed in cellular flow structures, possibly through a convective process. Erosion has produced nearly planar cross sections through these units. Near the SE edge of *HPT* exposures of *HT* rise up to 1 km to the plateaus of Alpheus Colles [*AC*]. At these locations the unit underlying the *AC* plateaus displays contorted betting similar in scale and pattern to the subjacent honeycomb terrain [*1*]. These plateaus may be resistant upper layers of the *HT*, perhaps having become chemically cemented. Wind erosion is postulated to have eroded at least 1 km of the less resistant lower portions of *HT* where exposed within the HPT. Additional evidence of stripping is afforded by pedestal craters with ejecta perched 300 to more than 1200 m above adjacent trough floors ('#' in Fig. 1).

Surface expression of bedrock. Bedrock exposures in the *HPT* are generally sharply defined in high-resolution CTX and HiRISE images, revealing the intricate layering of the *HT*. This suggests minimal dust mantling within the *HPT* despite the general dusty atmosphere within Hellas and a high dust index for the floor of the Hellas basin [*19*]. The observations above suggest deep erosion of the deposits within *HPT*, but obvious surface expression of aeolian erosion is rare. If wind erosion were the primary agent of erosion of *HPT* bedrock, accumulations of residual sand deposits as fields of aeolian dunes and megaripples might be expected, as suggested by [*2*]. HiRISE images in the *HPT* show scattered occurrences of megaripples, mostly in depressions but the great majority of the bedrock is free of aeolian bedforms. The orientation of the megaripples is generally consonant with southwesterly winds as simulated by the mesoscale model.

The erosion of up to 1 km of *HT* would imply that these deposits are fine-grained, but with sufficient cohesion to express bedding patterns. Erosion of such sediments might be expected to result in sculpting of the types of yardangs seen, e.g., in the Medusae Fossae deposits [*20*], but yardangs seem rare or absent.

We suggest that erosion of the *HPT* is strongly weathering limited, so that a process such as volatile sublimation or salt fretting slowly reduces cohesion of the bedrock, permitting grain-by-grain detachment. The result may be nearly planar bedrock exposures that cross-cut the bedrock stratigraphy. Such aeolian erosion may occur in Iran, where a salt-weathering peneplain cross-cuts bedrock exposures [*21*].

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Figure Captions:

Fig. 1. NW Hellas basin. *HT*= Honeycomb terrain, *AC*=Alpheus Colles, '#'=Pedestal craters. Image about 700 km across. Color-coded to show elevation differences on basin floor. High NW rim is unshaded.

Fig. 2. Regional winds in Hellas region. Hellas Planitia is bright area at lower right. Note strong katabatic and thermal contrast flow at SW edge of basin.

Fig. 3. Near-surface winds (m/s) at local 1 pm in region shown in Fig. 1.

Fig. 4. Maximum diurnal friction velocity (m/s) in same region.

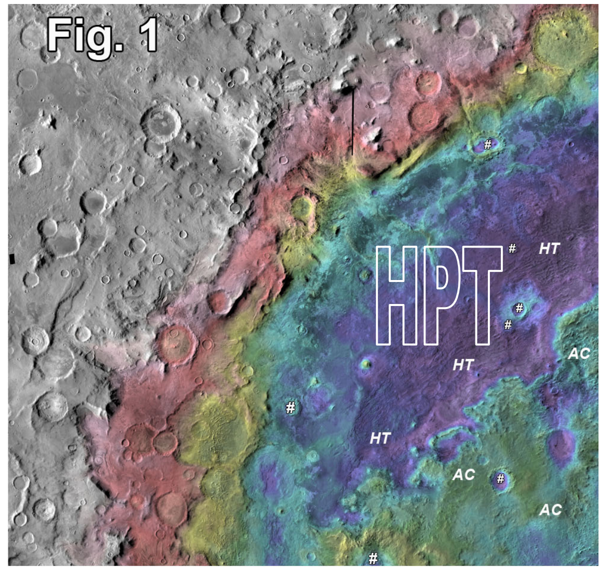

Fig. 2

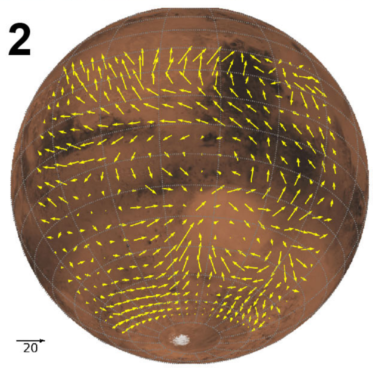

Fig. 3

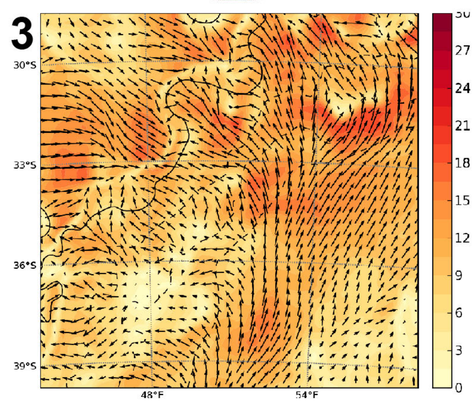

Fig. 4