INVESTIGATING THE ROLE OF AMAZONIAN MESOSCALE WIND PATTERNS ON THE SPATIAL DISTRIBUTION OF MARTIAN BEDROCK EXPOSURES. C. E. Gary-Bicas[1], T. I. Michaels[2], A. D. Rogers[1], L. K. Fenton[2], N. H. Warner[3], and J. C. Cowart[1], [1]Department of Geosciences, Stony Brook University, Stony Brook, NY, 11790, Carlos.Garybicas@stonybrook.edu, [2]SETI Institute, Mountain View, California, USA, [3]State Univ. of New York at Buffalo, Dept of Geology, 876 NSC, Buffalo, NY 14260-3050.

Introduction: Areally-extensive (>15 km^2) bedrock exposures throughout the Martian highlands have previously been mapped and documented using thermal and imaging datasets [1,8]. Bedrock exposures exhibit THEMIS thermal inertia (TI) values higher than 500 $Jm^{-2}K^{-1}s^{-1/2}$ (units hereafter omitted) and have relatively minor amounts of surficial sediment cover compared to typical highland surfaces [1,8]. Stratigraphic relationships and crater size-frequency distributions for these units indicate Noachian to Hesperian formation ages; but some are too small to permit accurate formation estimates and could be younger [2].

A major question regarding these ancient bedrock materials relates to how they have been preserved and/or exposed. Cratering rates in the early Solar System should have generated a ~decameter scale layer of regolith that obscured ancient bedrock [9]; indeed, meter-thick regoliths have been observed at the Spirit and InSight landing sites [10-11]. One potential explanation for bedrock exposure is that the rock is friable, leading to outcrop deflation and continual removal of comminuted materials through wind erosion [2]. Though this is a working hypothesis for many bedrock exposures, not all bedrock exposures exhibit textural characteristics consistent with friability [8]. Another potential explanation for present-day bedrock exposure is preservation through burial, and then later exhumation through more recent erosional processes. Finally, spatial variability in the energetics of Amazonian surface processes (e.g. wind) may have also played a role in bedrock exposure. Disentangling the competing roles of material properties and near-surface erosional processes is necessary for understanding the origin and preservation of ancient bedrock through the present day.

In this work, we investigate the role modern mesoscale wind patterns play in creating and/or maintaining the present-day spatial distribution of exposed bedrock using the Mars Regional Atmospheric Modeling System (MRAMS) [6]. Wind erosive strength is parameterized as Wind Erosion Potential (WEP), which is derived from the mass flux from sand saltation as a function of wind shear velocity [4]. **For multiple regions in the southern highlands, we addressed the following objectives:**

a) Determine whether plains with bedrock exposure exhibit a difference in WEP from plains that lack bedrock exposure.
b) *Within plains that contain bedrock exposures*, determine whether there is a relationship between WEP and TI (used as a proxy for bedrock exposure).

Data and Methods: We selected ten different locations in the Martian highland terrains of varying age and surface type based on map number 3292 from the United States Geological Survey (USGS) [5]. We cross-referenced these locations to known outcrops of exposed bedrock in the region as well as locations without them for contrast.

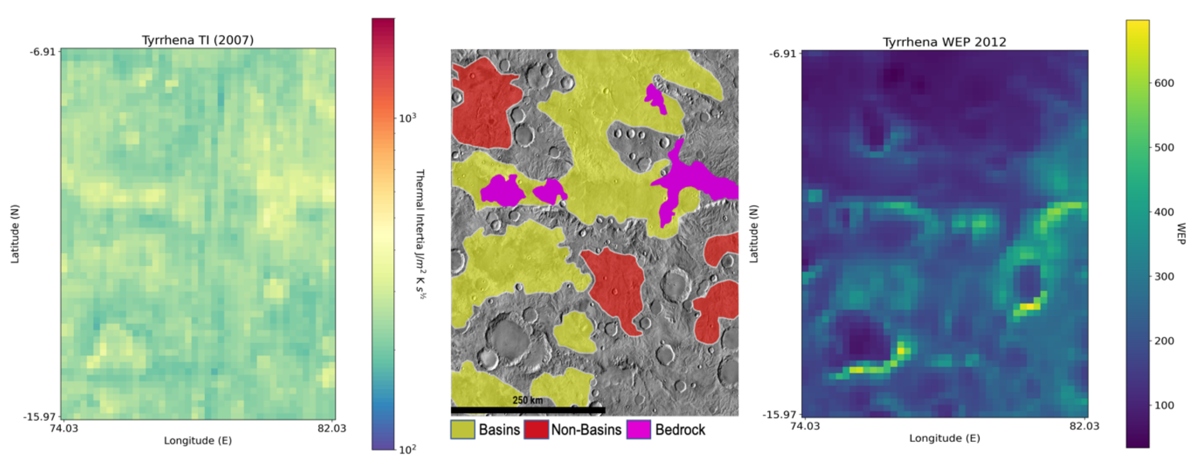

***Figure 1:** Left image is TES TI data for Tyrrhena Terra. Central image is classification in Tyrrhena Terra for TI and WEP analysis overlain on THEMIS daytime radiance mosaic. Bedrock taken from [8]. Right image is MRAMS WEP output for Tyrrhena Terra.*

Because our focus is on bedrock exposed in flat plains, rather than small exposures on crater walls, etc., we used MOLA/HRSC blended topography to delineate flat, contiguous plains and avoid topographic gradients that can lead to phenomena such as katabatic winds. We then classified flat plains locations as basins or non-basins depending on whether they were topographically-enclosed plains. Bedrock exposures are most commonly associated with basinal plains (Fig. 1).

We used global maps derived from the data obtained by the Thermal Emission Spectrometer (TES) onboard Mars Global Surveyor (MGS) [3] for TI. TI (eqn. 1) is the ability of any given material to retain heat, with higher TI suggesting greater heat retention:

$$I = \sqrt{k\rho c} \quad (1)$$

where k is thermal conductivity, ρ is material bulk density and c is specific heat.

We ran MRAMS to calculate WEP values for different study regions. MRAMS uses boundary conditions derived from a Mars General Circulation Model (MGCM) (Haberle et al., 1993) to calculate mesoscale atmospheric phenomena. WEP values were calculated for Ls 10°, 100°, 190°, 280°, to capture seasonal variability in wind patterns, and then summed to obtain an annual WEP value. We simulated 12 different climate states with different combinations of: two atmospheric pressures (7 and 14 mbar), four axial obliquities (25.19°, 34.64°, 54.61°, and 14.71°) and three solar longitudes of perihelion (251°, 71°, and 90°), to account for possible orbital configurations and atmospheric conditions that may have occurred in Mars' recent past (~ 250 Ma).

We then binned both the TES TI and MRAMS WEP into equally-spaced grids and extracted values for each of the plains units from each dataset. From the extracted data, we conducted statistical analyses to understand the relationship between TI and WEP for each unit as well as the differences between units.

Results: We have conducted analyses in three of our ten study regions but we will present the results for one of the locations (Tyrrhena Terra) (Fig. 1) with current Martian orbital and atmospheric conditions. We find that basins have slightly higher mean TI than the non-basins (Fig. 2); the basin TI distribution is right-skewed, likely due to the bedrock exposures contained within the basins. In contrast, non-basin units have higher mean WEP values compared to the basin units (Fig. 2).

We then cross-correlated each bin in the TI and WEP datasets for each unit to assess if there is any connection between TI and WEP for each respective unit. The basins and non-basins had no linear correlation between WEP and TI (Fig. 3).

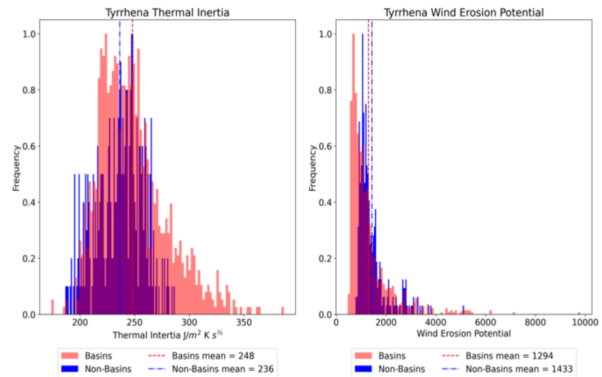

Figure 2: Left shows overlapping histograms of TES TI data from units found in Figure 1. Right shows corresponding histograms of their annual MRAMS WEP data. Dashed lines indicate distribution means.

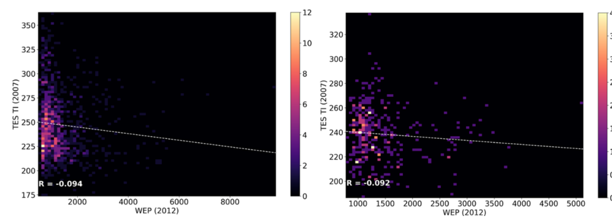

Figure 2: Left shows a 2-dimensional histogram of basins WEP vs. TI. Right shows non-basins. Dashed lines are linear regressions on data.

Conclusions and Future Work: Data from this location suggests that the basin units have higher TI but lower WEP compared to non-basin units. There was no linear relationship between TI and WEP in either of these units. To find out if there is any connection between TI and WEP, we will continue to investigate mesoscale wind patterns in other regions of the Martian highlands.

Acknowledgments: TES TI data can be found in the Planetary Data System (PDS). This work was funded by the Mars Data Analysis Project (MDAP) proposal number 80NSSC19K0021.

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