DISTRIBUTION OF MAT BIOSIGNATURES IN A WET AEOLIAN SYSTEM. R. C. Ewing[1] , M. M. Tice,[1], C. Neal[1], H. Patel[1], M. Coker[1], K. Cheffer, Texas A&M University, Department of Geology and Geophysics, 3115 TAMU, College Station, TX 77843, rce@tamu.edu

Introduction: Assessing the environmental conditions and processes that influence preservation or degradation of biosignatures is a primary goal of planetary exploration. Sedimentary environments are a primary exploration target for biosignatures [1]. Within these environments sediment particles, and potentially biological material, are mobilized by a fluid from a source area and deposited in a sedimentary sink. Thus, determining the preservation potential of biosignatures within a sedimentary environment hinges upon understanding the types and rates of processes that erode, transport, deposit, and alter sediments, and, in turn, how these processes are connected to textural and geochemical biosignatures preserved within the deposits.

Wind-blown modern and ancient sedimentary environments are a recognized extreme habitable environment on Earth and are ubiquitous across modern environments on Venus, Mars, Titan, Comet 67P/ Churyumov–Gerasimenko, and putatively Pluto, and within ancient environments on Mars [2, 3]. Although, wind has clearly played a significant role in shaping the worlds within our solar system and wind-driven processes have likely interacted with any surface biosphere that exists or existed on these worlds, aeolian environments are underexplored as potential archives of life signatures [4]. Because of the limited focus on biosignatures of aeolian environments, a gap remains in our understanding of the distribution of biosignatures within aeolian environments, how organisms and sediment are eroded, transported, deposited and preserved in aeolian geomorphology and stratigraphy, and what textural and geochemical biosignatures are within aeolian stratigraphy and how to detect them.

We present initial results examining the distribution of microbial mats occurring within wind tidal flats and the interdune areas of a wet aeolian system on Padre Island, Texas.

Methods: Satellite imagery, aerial photos, and lidar topographic surveys were used to characterize the macroscale morphology and spatial distribution of microbial mats and sand dunes across Padre Island near Mansfield Pass. Trenches were dug to characterize the mats within the wind tidal flat and interdune stratigraphy. A handheld XRF was used to characterize the geochemistry of the trench stratigraphy and mat surface XRF measurements were taken in a 1 m x 1 m grid at 5cm increments to characterize the microbial mat surface geochemistry. Sediment peels were used extract the trench surface as a two-dimensional textural sample for laboratory x-ray florescence (XRF) analysis.

Results: Satellite and aerial photo examination revealed that microbial mats extensively cover the wind tidal flats and patchily cover interdune areas adjacent to active dunes. Patches of microbial mat, more extensive than those within the interdune areas, occur marginal to the active dune field (Fig. 1). Time-series image analysis shows the extent of exposed microbial mat and active sand varies seasonally within the active dune field, but less so in the wind tidal flat. Microbial mats are most exposed in fall and winter and most covered by sand during spring and summer.

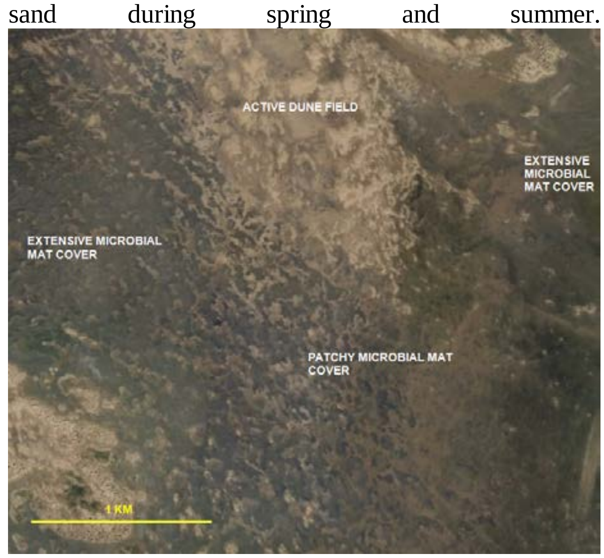

Figure 1: Satellite image of microbial mat and dune field at Padre Island, Texas.

In situ investigation of the microbial mat showed that the best developed mats occurred within the wind tidal flats and dune-field marginal areas, and had 1-2 cm thick mat surface, whereas the least developed mats occurred within the dune field had sub-cm scale active surface. Surface microbial mat textures ranged from microscale roughness with no visible organization on the surface to structures organized into ripple-like bedforms (Fig. 2).

Figure 2: Microbial mats developed into bedform-like sinuous ridges. Dark areas represent active mat and light areas are loose sand.

Mat patches were more indurated and less permeable than surrounding sand as evidenced by standing water on the mat surface compared to damp, sandy areas adjacent.

Trenching revealed poorly stratified deposits within the wind tidal flats and well-stratified deposits within the interdune areas (Fig. 3). Wind tidal flat deposits had a massive structure with no visible sedimentary structures. Interdune deposits had alternating light and dark, parallel, mm-scale lamination. The lamination at the surface had a crinkly texture and below 10 cm was planar.

Figure 3: Stratified interdune deposit. Alternating light and dark layers indicate periods of microbial growth (dark) and sand deposition (light).

The spatial distribution of microbial mats, the complexity of the surface texture, and degree of visible sedimentary structures in the tidal flat and interdune deposits appears to relate to the degree of wind-blown sand activity. Areas with little activity had persistent, stable microbial mats and no sedimentary structures in the subsurface. However, deposits adjacent to and within the dune field where sand activity varied seasonally, had well developed stratification. The stratification could relate to periods of sand mobilization during which mats were covered or eroded, and periods of stabilization during which the microbial mat could grow. Large-scale microbial patches may be nucleation sites whereby stable, persistent patches increase in size during the wet season and are eroded back during the active aeolian season, but do not disappear during the seasonal cycle. This patchiness at the surface may also be reflected as heterogeneity in the deposits with variable massive and laminated stratification.

References: [1] Hays et al., (2017) Astrobiology 17.4, 363-400. [2] Diniega, S. et al. (2016) *Aeolian Research* , 26, 5-17. [3] Grotzinger et al., (2005), EPSL, 240.1, 11-72. [4] Neuman, et al. (1996) *Catena* 27.3-4, 229-247.