Possible (or not) microbialites in the < 3.7Ga Gillespie Lake Member, Mars. N. Noffke[1], [1]Old Dominion University; 4600 Elkhorn Avenue, Norfolk, Virginia 23529, USA, nnoffke@odu.edu.

Introduction: Sandstone beds of the < 3.7 Ga Gillespie Lake Member on Mars have been interpreted as lake and river deposits that over time fell dry. On Earth, such settings are colonized by microbial mats; geological studies revealed that terrestrial microbial mats cause microbially induced sedimentary structures (MISS) in clastic sediments such as sand. MISS form by the interaction of sediment-stabilizing microbial mats with physical sediment dynamics (erosion and deposition). Such structures can become fossil; the oldest MISS on Earth occur in the ca. 3.48 Ga Dresser Formation, Pilbara, Western Australia. Because of the similar ages of both the Gillespie Lake rocks on Mars and the Dresser Formation rocks on Earth, aim of this study was to search for possible MISS in the Martian deposits.

Observations: Three lithofacies of the Gillespie Lake Member sandstone display cm- to m- scale structures that are similar to terrestrial MISS including 'erosional remnants and pockets', 'mat chips', 'roll-ups', and others [1]. These MISS-like structures identified in the rover Curiosity images seem not to have a random distribution; rather they appear to be arranged into spatial associations and temporal successions. Such associations and their temporal successions are known from terrestrial MISS-forming microbial mats in similar environments. One site in the Gillespie Lake Member displays a fossil surface inbetween two rock beds where the morphological relief appears to be similar to that of the exposed bed surfaces.

Discussion: Terrestrial MISS are generally quite distinct and can rarely be masked by abiotic processes. However, this may not be the case for the Martian material although abiotic processes that may have shaped the surface morphologies on Mars during a time that long ago are still widely unknown; but also must have the exposed surfaces experienced post-depositional erosion and alteration. Examples include pits caused by saltation of pepples or dissolution of less resistant portions of lithologies; clasts caused by flaking; cracks caused by frost weathering, insolation, etc. However, the site displaying a possible ancient morphology may indicate that the surface relief is original. On Earth, the MISS associations would record the development of a microbial mat ecosystem, which then was subject to desiccation of the setting. An apparent arrangement of the structures on Mars may be just coincidence.

Conclusion: The observations do not allow any conclusion on biogenicity of the sedimentary structures on Mars; the conclusion of the study therefore is the hypothesis that the sedimentary structures in the Gillespie Lake Member are fossil MISS. In order to verify or falsify this hypothesis, the 'Criteria of Biogenicity of MISS' must be fulfilled. These include detection, identification, confirmation and differentiation. A critical amount of sedimentary structures of comparable morphology must be found to have a statistical base of morphological comparisons allowing identification as MISS; petrological analyses on thin-sections obtained from returned samples must be conducted allowing confirmation that the candidate structures are indeed biological. Only continuous research will allow understanding of past Martian environments and the differentation of possible biological from non-biological structures.

Reference:

[1] Noffke, N. (2014) *Astrobiology*, *15*, 169-192.