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The sabkhas of Qatar: modern analogues for studying early life on Earth and on Mars

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The study of early life on Earth and the search for life on Mars often includes investigations of modern analogues: natural environments that share similarities to what we hypothesize may have existed on the early Earth and early Mars. The study of modern analogues provides key information on how biosignatures are formed and preserved, which is essential for interpreting the geological record. Research conducted in recent years in various modern sabkhas located along the coast of Qatar have demonstrated that these extreme evaporitic environments represent an inspirational gold mine for the field of geobiology and astrobiology.

The intertidal zones of the Qatari sabkhas are typically colonized by microbial mats. Their presence leads to the formation of Microbially Influenced Sedimentary Structures (MISS). Examples of studied MISS include polygonal, domical, blistered, tufted and crinkled microbial mats. We discuss biological vs. physiochemical factors responsible for their formation, as well as their fossilization potential. These MISS often occur in a precise sequence along a transect from the lower to the upper intertidal zone. We propose that a MISS sequence represents a stronger morphological biosignature than a single MISS. The community composition of some of the studied mats revealed an uppermost layer dominated by anoxygenic phototrophs. We propose that such mats represent a particularly good analogue for studying life in the Early Archean, a time when the cyanobacteria that usually dominate the uppermost photo-oxic layer of most modern mats probably did not exist.

Besides influencing sediment morphology, the extracellular polymeric substances (EPS) constituting the mats serve as nucleation sites for the precipitation of authigenic minerals. Among these possible precipitates, our research focused on microbially influenced Mg-rich carbonates and Mg-rich silicates. Linking these minerals to a microbial process is of particular interest in view of the forthcoming rover missions to Mars (i.e., ExoMars and Mars 2020). Indeed, orbital spectral

analyses revealed the presence of Mg-rich clays and Mg-rich carbonates in the surroundings of the proposed landing sites. It will be exciting to test the hypothesis that, on Mars, some of these minerals may have formed at low temperatures from liquid water and may, therefore, represent a target phase for the investigation of biosignatures.