MICROBIAL MATS IN PLAYA LAKES AND OTHER SALINE HABITATS: EARLY MARS ANALOG?

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Microbial mats are cohesive benthic microbial communities which inhabit various Terra (Earth-based) environments including the marine littoral and both permanent and ephemeral (playa) saline lakes.[1] The Terran fossil record for such communities (stromatolites and microfossils) extends back to ca $\geq 3.5 \times 10^9$ years before present, a time when it is considered probable that Mars possessed a warmer, more humid climate than it has at present.[2] Certain geomorphological features of Mars, such as the Margaritifer Sinus, have been interpreted as ancient, dried playa lakes, presumably formed before or during the transition to the present Mars climate. Studies of modern Terran examples suggest that microbial mats on early Mars would have had the capacity to survive and propagate under environmental constraints that would have included irregularly fluctuating regimes of water activity and high ultraviolet flux. Assuming that such microbial communities did indeed inhabit early Mars, their detection during the MRSR mission depends upon the presence of features diagnostic of the prior existence of these communities or their component microbes or, as an aid to choosing suitable landing, local exploration or sampling sites, geomorphological, sedimentological or chemical features characteristic of their playa lake habitats. Examination of modern Terran playas (e.g., the Lake Eyre basin) shows that these features span several orders of magnitude in size (Fig. 1). For example, ephemeral stream floodplains and æolian dune fields are large-scale features consistent with playa lake systems. Smaller-scale features include those indicative of groundwater emergence (e.g., mound springs, megapolygons), subaerial exposure (e.g., desiccation polygons), or hypersaline conditions (e.g., evaporite minerals such as gypsum and halite). While stromatolites are commonly centimeter–meter scale features, bioherms or "fields" of individuals may extend to larger scales. Desiccation, though preventing bacterial degradation of non-lithified mats, produces structures vulnerable to physical destruction/removal via æolian erosion.[3] Preservation of organic matter (mats and microbes) would, however, be favored in topographic lows such as channels or ponds of high salinity particularly those receiving silica-rich groundwaters. These areas are likely to be located near former zones of groundwater emergence and/or where flood channels entered the paleo-playa. Fossil playa systems which may aid in assessing the applicability of this particular Mars analog include the Cambrian Observatory Hill Beds of the Officer Basin[4] and the Eocene Wilkins Peak Member of the Green River Formation.[5]

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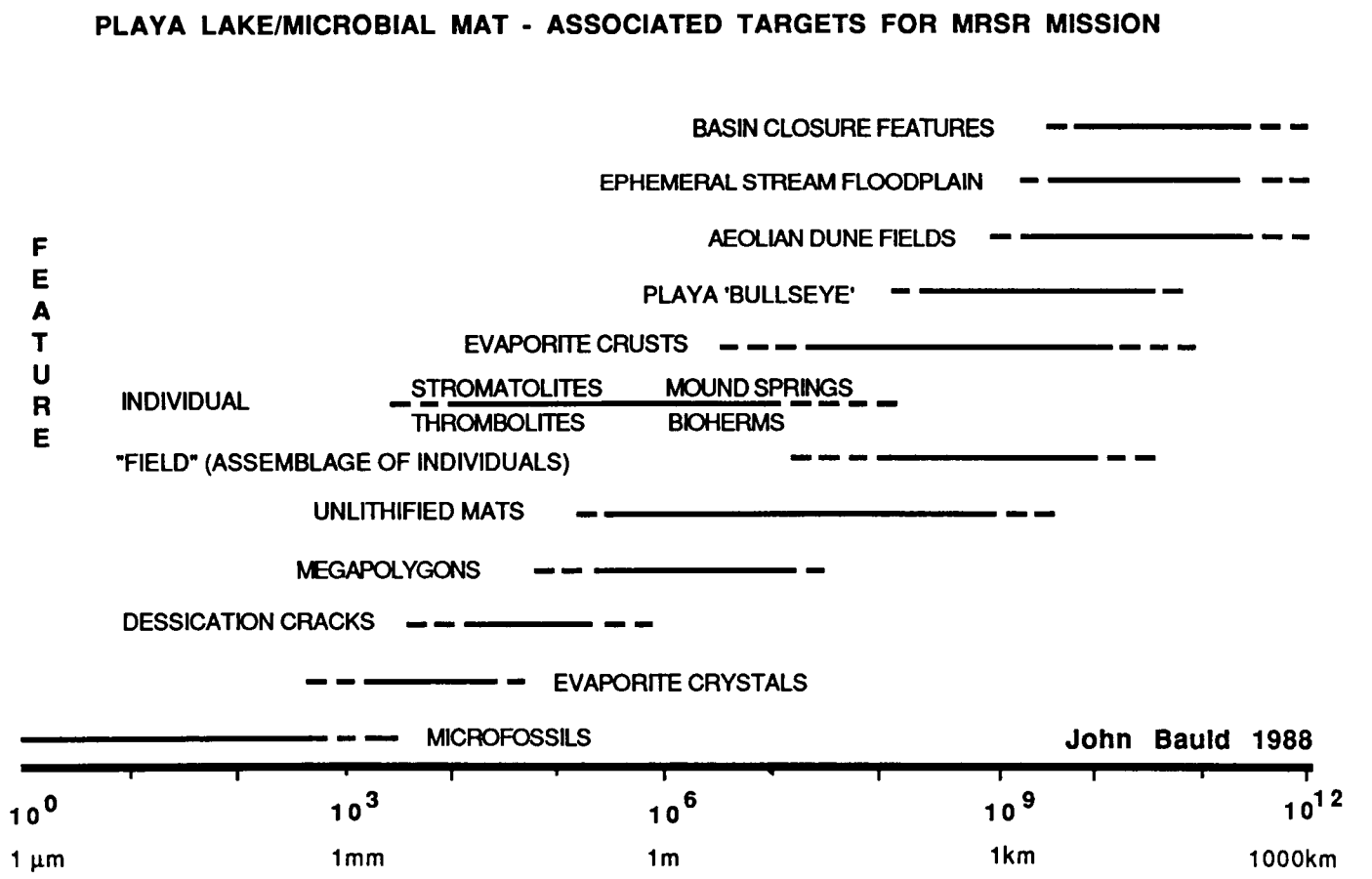

Figure 1. Approximate dimensions of biogenic and environmental targets diagnostic of, or consistent with, the former presence of saline/playa lake-hosted microbial mat communities on Mars.