

What are Microbial Mats and Stromatolites?

Microbial mats are complex communities of microbes, usually organized into layers that can be seen with the naked eye. They were one of the earliest ecosystems on Earth. Photosynthetic mats were responsible for creating the oxygen-rich atmosphere that we breathe. Stromatolites, our oldest fossils, are microbial mats with a mineral (rock) component.

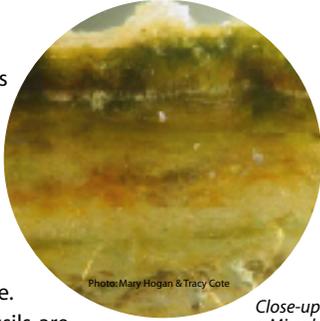
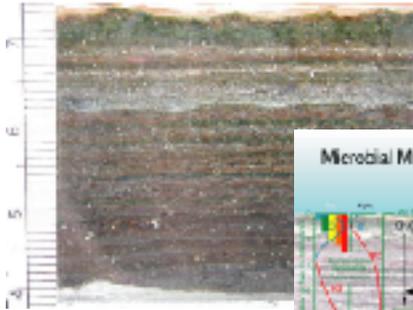
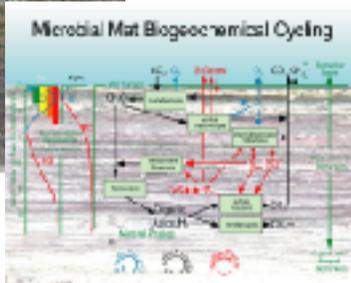


Photo: Mary Hogan & Tracy Cote

Close-up View of a Microbial Mat



Side view of a mat from a hypersaline (salty) environment. The small divisions on the ruler are millimeters.



Microbial mats are complete ecosystems in miniature, and conduct complex biogeochemical transformations (e.g., photosynthesis, nutrient cycling) over extremely small spatial scales.



Photomicrograph: Lee Prufert-Bebout

Because microorganisms in mats are so closely associated, mats are a great place to study interactions that occur. This microscopic view of the inside of a microbial mat shows many types of microbes, including cyanobacteria and purple sulfur bacteria.

Where are Microbial Mats Found?

Simple mats can be found in streams, lakes, soils, even drinking fountains and rain gutters. These are relatives of the oldest forms of life on Earth! The more complex microbial mats that NASA studies have often evolved to live in "extreme environments" (hot, cold, salty, or dry habitats, even inside rocks) where they are safe from grazing animals.



Hot Springs in Yellowstone National Park



A Thin Microbial Mat from a Tidal Flat in Baja California, Mexico



Salt Marsh Microbial Mats, Sippewissett, MA



Microbial Mat Inside Gypsum Crystals from Baja California, Mexico

Why is NASA Studying Microbial Mats?

Mats help us to understand the interaction of Earth's past life and its environment, and are centrally important to NASA's search for evidence of life both within and outside our solar system.

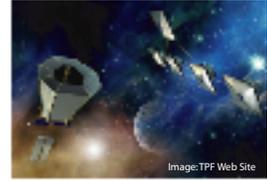


Image: TPF Web Site

Gases produced by mats may accumulate in the atmospheres of extrasolar planets, to be detected by missions such as Terrestrial Planet Finder.

Evidence for hypersaline (salty) environments, perfect places to find mats on Earth, has been reported by the Mars Exploration Rovers!



Image: MER Web Site

In addition to gases, microbial mats may produce structures, minerals, or chemical compounds (collectively called "biosignatures") that may be discovered with robotic explorers.

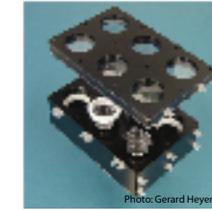


Photo: Gerard Heyenga

Mats are complete, functioning ecosystems in microscale. They may be extremely useful for studying the effects of space flight on biological processes.



Macro photography by Bruce J. Russell

NASA-funded scientists are engaged in both laboratory and field-based research on microbial mats in order to better understand how the ecology of these mats determines the kinds of biomarkers that mats have left on Earth, and may be creating on other worlds.



Photo: Courtesy NASA



Photo: Steven Carpenter