# Terrestrial microbial mats at 3,220 Myr ago (Moodies Group, SA)

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The Paleoarchean Moodies Group of the Barberton Greenstone Belt represents the world's oldest alluvial to tidal deposit and contains abundant fossil traces of a diverse microbial ecosystem. Widespread photosynthetic microbial mats were thriving along a siliciclastic tidal coast, while bedding-parallel cavities beneath the mats were also colonized by microbes. Recently discovered benthic microbial mats draping alluvial-fluvial conglomerates and sandstones now expand this early ecosystem to paleoenvironments that were clearly terrestrial. Field, petrographic, and geochemical analyses confirm the terrestrial and freshwater habitat of these unique fossil mats as well as their biogenicity and syn-sedimentary origin. The mats are preserved as carbonaceous laminations up to 4 mm thick that demonstrate numerous properties characteristic of younger and extant examples, including cohesive and erosion-resistant behavior, an abundance of filamentous cells, and the trapping of detrital sediment particles. Raman analyses show that the laminae have experienced temperatures of ~360°C, consistent with regional peak metamorphic temperatures of the host rocks and demonstrating syngenicity. The terrestrial mats yield $\delta^{13}C_{org}$ values ranging between -23.4‰ and -17.9‰, which are on average 7‰ higher compared to coeval marine mats from nearby intertidal deposits, suggesting significant paleo-environmental or paleo-metabolic diversity across this early ecosystem. These fossils from the Moodies Group constitute the first direct, macroscopically-visible trace of life on land and support the antiquity of a flourishing terrestrial biosphere at least as far back as 3,220 Myr ago.

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