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Microbial mats in the terrestrial Lower Triassic of North China and implications for the Permian-Triassic mass extinction

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Microbial mats have been repeatedly reported in marine Lower Triassic rocks, but scarcely mentioned in the post-mass extinction terrestrial facies. Here, five kinds of microbially induced sedimentary structures (MISS) or sedimentary surface textures were recognized through studies of morphological and microscopic characteristics combining two kinds of present classification schemes, including ‘old elephant skin’ textures, wrinkle structures, palimpsest ripples, *Manchuriophycus* structures and synaeresis sand cracks, from the terrestrial Lower Triassic Liujiagou Formation in North China. On the basis of this study and review of the literatures, we propose a general model for the in situ preservation of microbial mats and the interrelation with various MISS. The depositional environment investigation demonstrated that the microbial communities adapted not only to the periodically desiccated conditions, but also to the storm-dominated paleoenvironments in the Liujiagou Formation. The Permian-Triassic mass extinction in North China was represented by the die-off of plant fossils, the disappearance of coal beds, the extinction of pareiasaurs among tetrapods, the decline of bioturbation levels and the dramatic change of sedimentary systems through the Sunjiagou Formation. The Sunjiagou Formation recorded the turnover from an ever-wet to a progressively drier and hotter climate and it is the witness of the terrestrial Permian-Triassic mass extinction in North China. Following this mass extinction, MISS became much more common and widespread, which suggests that the mass extinction provided favorable biological and environmental conditions for the development of the MISS in terrestrial ecosystems, especially the decreased bioturbation intensity and grazing pressure associated with the increased temperature and climatic drying. At the upper part of the Liujiagou Formation and the overlying Heshanggou Formation, the disappearance of MISS coupled with the increased bioturbation might indicate an improvement of terrestrial ecosystems and represent the prologue of the Triassic biotic recovery. However, as the investigation of MISS in space and time through the geological record is in its early stage, further geobiologic and geochemical studies as well as high-precision isotopic dating from Permian-Triassic terrestrial successions are needed to fully reveal the timing and pattern of the Early Triassic terrestrial ecosystem reconstruction.

