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Microbially-induced carbonate precipitation, Moodies Group (3.2 Ga, BGB, South Africa)

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The Archean Moodies Group, Barberton Greenstone Belt (BGB), ~3.2 Ga, represents Earth's oldest known tidally influenced siliciclastic sequence and includes well-preserved microbial mats which can be traced laterally for >15 km.

We investigated the microstructure of crinkly intertidal-facies mat morphotypes and tufted supratidal-facies mats, both preserved as abundant kerogenous laminae ~1mm thick overlying individual depositional events in medium- to coarse-grained sandstones. Mats are widely underlain by up to 40 cm long and few mm-thick monomineralic layers; microbial tufts (1-2 cm in height) show increased calcification within their interior. XRF elemental scanning of fresh slabbed and polished handsamples indicates (1) that the monomineralic layers underlying the microbial mats consist of pure carbonate (calcite, dolomite), now largely replaced by microcrystalline quartz, and that (2) Fe is enriched in the kerogenous mat remnants. SEM observations of freshly exposed kerogenous surfaces show interwoven, bundled and twisted filaments 1-3 µm in diameter, confirming mat biogenicity.

The close association of carbonate layers and microbial mats suggests that mat metabolic activity promoted their formation. An autotrophic metabolism, such as CO_2 fixation, would have increased the alkalinity of the pore fluid beneath the mat and induced carbonate precipitation. Alternatively or additionally, carbonate could have formed as a byproduct of a Fe-reducing metabolic pathway. Middle Archean photic-zone filamentous microbial mats may have, at least in its upper layers, employed a photosynthetic strategy.