Different phases of carbonaceous matter in microbial mats of the Moodies Group in the Barberton Greenstone Belt, South Africa

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It is a known phenomenon in Archean rocks that carbonaceous matter (CM) analysed by Raman spectroscopy shows strong nano-scale heterogeneities in thermal maturation. It is crucial to determine were exactly such heterogeneities stem from since Raman spectroscopy of CM is often used to infer the syngeneity of the material. Several mechanisms for the formation of such heterogeneities have been proposed in literature, some of which strongly suggest an allochthonous post-depositional input of CM.

The Moodies Group (ca. 3.2 Ga) of the Barberton Greenstone Belt in South Africa is a well-studied and well-preserved siliciclastic tidal Archean deposit. The Moodies Group contains microbial mats that are preserved as kerogenous 0.5 to 1 mm thick laminations. Raman spectroscopic data collected on carbonaceous material present within and in between the laminations revealed differences in structural order of the CM within one single thin section (ca. 4x2.5 cm). Up to 3 different phases of CM per thin section were identified. The likelihood of a post-depositional contamination with CM in the Moodies microbial mats can be ruled out since no petrographic nor stratigraphic indications of hydrothermal overprint or post-depositional fluid circulation were found.

It has been suggested before that the structural variability of CM in metamorphic rocks can also reflect chemical and molecular heterogeneity of the precursor organic material. It is quite likely that the Moodies microbial mats contained bacteria which utilized different sorts of metabolisms. Chemical divergences in these bacteria thus could lead to different graphitization patterns within the biomats. We therefore conclude that the heterogeneities we see today in Moodies microbial mat CM likely stems from differences in the precursor material and that the microbial mats are probable syngeneic.