Micro to nanostructures of carbonaceous materials in 3.2 Ga banded iron formations, Moodies Group, Barberton Greenstone Belt, South Africa

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Archaean microfossils and microbial mats have been important subjects for understanding early earth ecosystem (Noffke et al., 2006; Homman et al., 2016), although the authenticity is sometimes controversial. Here, we performed detail micro-nanoscale observation of organic materials extracted by various methods, together with constraints from geological, petrological and geochemical data on ~3.2 Ga BIFs of Sheba gold mine, Moodies Group, Barberton Greenstone Belt, South Africa.

Collected samples were classified into sandy-siltstone, carbonate-rich siltstone and magnetite-rich siltstone from the petrology whereas most of them show enough iron contents to be defined as BIFs, suggesting iron deposition at quite shallow environments. Contents and stable isotope ratios of organic carbon in the samples indicate 0.03–0.29 wt% and ~–27 ‰. Metamorphic temperature calculated by Raman spectrum of acid-extracted organic materials was roughly consistent with that of Moodies group. 30–50 μm flake, > 100 μm filament and ~50 μm indeterminate-shape organic materials were observed in all three rock types at different rates. SEM and TEM observations of flaky organic materials collected by microsampling show unique surface structures covered by ~1 μm projections, sometimes associated with Fe, Ti, and Cr-bearing nano-minerals.

Our results indicate morphological variety of the organic materials in Moodies BIF, which suggests multiple microbial species and fluctuation of the microbial activities associated with the depositional setting. The complex surface structures of flaky organic materials accompanied by nano-minerals indicate microbial mats trapping nano-sized detritus and precipitates were widely flourished on shallow BIFs at 3.2 Ga.

[1] Noffke *et al*. (2006) *Geology*, **34**, 253–256. [2] Homman *et al*. (2016) *Geology*, **44**, 51–54.