Molecular signatures from kerogens preserved in 3.42 Ga microbial mats (Buck Reef Chert, Barberton Greenstone Belt, South Africa)

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The 3.42 Ga Buck Reef Chert (Barberton Greenstone Belt, South Africa) provides a rare sequence of exceptionally well preserved silicified microbial mats, containing abundant kerogen[1]. We investigated this macromolecular organic material (cherts from drill cores, Barberton Drilling Project - Peering into the Cradle of Life) on structural (microscopy, FTIR/ATR, Raman), and molecular level (HyPy followed by GC-MS). Kerogen is solely associated with microbial mat structures and not entrapped in any post-depositional veins or microfractures. Raman confirmed the regional peak metamorphic temperatures (greenschist facies) and therefore supports the syngeneity of the kerogens. While FTIR/ATR mostly indicated an overall graphitic structure, GC-MS after HyPy treatment revealed robust above-blank-concentrations of aliphatic and aromatic hydrocarbons. In the two-step heating approach used (330 °C / 520 °C), these compounds exclusively occurred in the high-T HyPy runs, thus pointing to cracking of covalent bonds in the kerogens. Detected *n*-alkane homologues (C_{12}–C_{26}) showed a noticeable decrease in abundance after *n*-C_{16} and *n*-C_{18}. Further, isomeric mixtures of monomethyl alkanes (C_{12}–C_{21}) and low amounts of PAHs were found. Preferences in chain-length of *n*-alkanes are not known from abiotic organic matter (FTT and extraterrestrial). The idea that these distributions instead may represent a syngenetic biological signal, is supported by (i) the thermal stability of *n*-alkanes[2] (ii) the careful state-of-the-art kerogen isolation, including extensive extraction, swelling, and blanks, (iii) the two-step HyPy approach used, (iv) similar findings in hydropyrolysates from >3.4 Ga chert kerogens of the Pilbara Craton[3],[4], and (v) the occurrence of kerogen exclusively in microbial mat structures. To further decode the origin of these molecular fingerprints, compound specific stable carbon isotopes will be analyzed.

[1] Homann (2019), *Earth Sci. Rev.* **196**, e102888. [2] Price (1993), *Geochim. Cosmichim. Acta* **57**, 3261–3280. [3] Marshall et al. (2007), *Precambrian Res.* **155**, 1–23. [4] Duda et al. (2018), *Biogeosciences* **15**, 1535–1548.