Supplement of

Ideas and perspectives: hydrothermally driven redistribution and sequestration of early Archaean biomass – the “hydrothermal pump hypothesis”

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Fig. S1. Hydrothermal chert veins of the ca. 3.5 Ga Dresser Formation (Pilbara Craton, Western Australia). (a) Hydrothermal chert veins of the Dresser Formation (ridges, see arrows) forming large-scale networks in their host basalts. (b) Hydrothermally altered footwall basalts exhibiting pillow structures (arrows); hammer for scale (red circle). (c, d) Hydrothermal chert veins of the Dresser Formation penetrating komatiitic footwall basalts in a recent cut wall of the abandoned Dresser Mine (persons for scale). The analysed hydrothermal chert vein occurs adjacent to the one shown in (d).
**Fig. S2.** Total ion current chromatograms. Low-temperature (a) and high-temperature (b) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. Compounds detected in (a–c) represent background contamination and/or artefacts. Note that high-temperature HyPy of the Dresser kerogen yielded significantly higher amounts of products with a distinctly different distribution pattern. Black dots: \( n \)-alkanes (numbers refer to carbon chain-lengths); triangle: phthalic acid; N: naphthalene; MN: methylnaphthalenes; BiPh: 1,1’-biphenyl; DMN: dimethylnaphthalenes; MAN: methylacenaphthenes; P: phenanthrene; crosses: siloxanes (GC column or septum bleeding); squares: phenols; S: sulphur.

Note: Percentage values given on the vertical axes of chromatograms (a–c) relate peak intensities to chromatogram (d) (HyPy Dresser kerogen, 330–520°C).
**Fig. S3.** Partial ion chromatograms selective for alkanes (m/z 85). Low-temperature (a) and high-temperature (b) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. High-temperature HyPy produced the highest yields of n-alkanes and minor clusters of isomeric monomethylalkanes (diamonds in d). The n-alkanes in the high-temperature pyrolysate of the Dresser kerogen (d) furthermore exhibit a distinct distribution different to those observed in (a–c). All compounds detected in (a–c) are considered to represent background contamination. Black dots: n-alkanes (numbers refer to carbon chain-lengths).

Note: Percentage values given on the vertical axes of chromatograms (a–c) relate peak intensities to chromatogram (d) (HyPy Dresser kerogen, 330–520°C).
Fig. S4. Ion chromatograms selective for aromatic hydrocarbons ($m/z$ 128, 142, 154, 156, 168, 178). Low-temperature (a) and high-temperature (b) HyPy products of analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. Note that high-temperature HyPy of the Dresser kerogen yielded a variety of aromatic hydrocarbons, which are orders of magnitudes lower or absent in all other pyrolysates. Black dots: $n$-alkanes (numbers refer to carbon chain-lengths); N: naphthalene; MN: methylnaphthalenes; BiPh: 1,1’-biphenyl; DMN: dimethylnaphthalenes; AN: acenaphthene; MBiPh: methylbiphenyls; DBF: dibenzofuran; MAN: methylacenapththenes; P: phenanthrene; crosses: siloxanes (GC column or septum bleeding); S: elemental sulphur (likely derived from the sulfidic catalyst).

Note: Percentage values given on the vertical axes of chromatograms (a–c) relate peak intensities to chromatogram (d) (HyPy Dresser kerogen, 330–520°C).
**Fig. S5.** Partial ion chromatograms selective for (dimethyl-, methyl-)naphthalenes (m/z 128, 142, 156). Low-temperature (a) and high-temperature (b) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. High-temperature HyPy of the Dresser kerogen yielded naphthalene (N), methylnaphthalenes (MN), dimethylnaphthalenes (DMN) and acenaphthene (AN), which are orders of magnitudes lower or absent in all other pyrolysates. Black dots: n-alkanes (numbers refer to carbon chain-lengths); S: elemental sulphur (likely derived from the sulfidic catalyst).

Note: Percentage values given on the vertical axes of chromatograms (a–c) relate peak intensities to chromatogram (d) (HyPy Dresser kerogen, 330–520°C).
**Fig. S6.** Partial ion chromatograms selective for (methyl-)phenanthrenes (m/z 178, 192). Low-temperature (a) and high-temperature (b) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. Phenanthrene (P) and traces of methylphenanthrenes (MP) were only present in the high-temperature HyPy pyrolysate of the Dresser kerogen. Squares: phenols; S: elemental sulphur (likely derived from the sulfidic catalyst).

Note: Percentage values given on the vertical axes of chromatograms (b–d) relate peak intensities to chromatogram (a) (HyPy blank, ~21–330°C).
Fig. S7. Ion chromatograms selective for branched alkanes with quaternary carbon centres (BAQCs; m/z 127). Low-temperature (a) and high-temperature (b) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. Compounds detected in (a–c) represent background contamination and/or artefacts. Note the absence of BAQCs in all pyrolysates. Black dots: n-alkanes (numbers refer to carbon chain-lengths); diamonds: monomethylalkanes; N: naphthalene; BiPh: 1,1’-biphenyl; crosses: siloxanes (GC column or septum bleeding); S: elemental sulphur (likely derived from the sulfidic catalyst).

Note: Percentage values given on the vertical axes of chromatograms (a–c) relate peak intensities to chromatogram (d) (HyPy Dresser kerogen, 330–520°C).
Fig. S8. Ion chromatograms selective for hopanes (m/z 191). Low-temperature (a) and high-temperature (b) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. All compounds in (a–d) represent background contamination and/or artefacts. Note the absence of hopanes in all pyrolysates. Crosses: siloxanes (GC column or septum bleeding); squares: phenols. Note: Percentage values given on the vertical axes of chromatograms (c–d) relate peak intensities to chromatogram (a) (HyPy blank, ~21–330°C).
Fig. S9. Ion chromatograms selective for steranes ($m/z$ 217). Low-temperature (a) and high-temperature (b) HyPy chromatograms of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. Note the absence of steranes in all chromatograms.

Note: Percentage values given on the vertical axes of chromatograms (a–c) relate peak intensities to chromatogram (d) (HyPy Dresser kerogen, 330–520°C).
Fig. S10. Stable carbon isotope values ($\delta^{13}$C) of $n$-alkanes released upon high-temperature HyPy and the total organic carbon (TOC). The isotopic similarity indicates that the $n$-alkanes (black dots) were generated from the kerogen (TOC, red dot).

Vertical lines: Standard deviations of $\delta^{13}$C values; dotted horizontal line: mean $\delta^{13}$C value of $n$-alkanes (-31.4 %); shaded area: standard deviation of mean $\delta^{13}$C value of $n$-alkanes ($\pm 1.2 %$).