



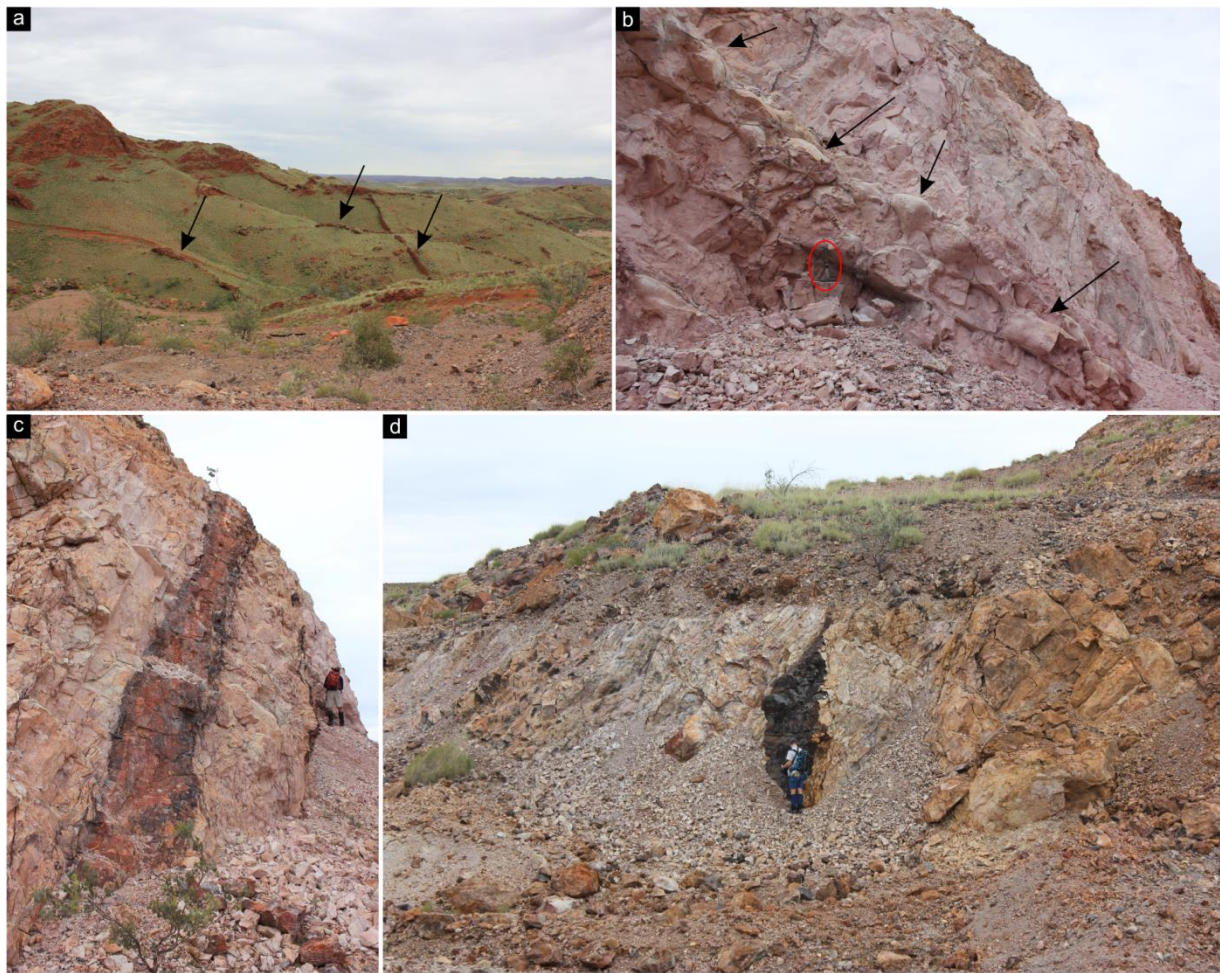
## *Supplement of*

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

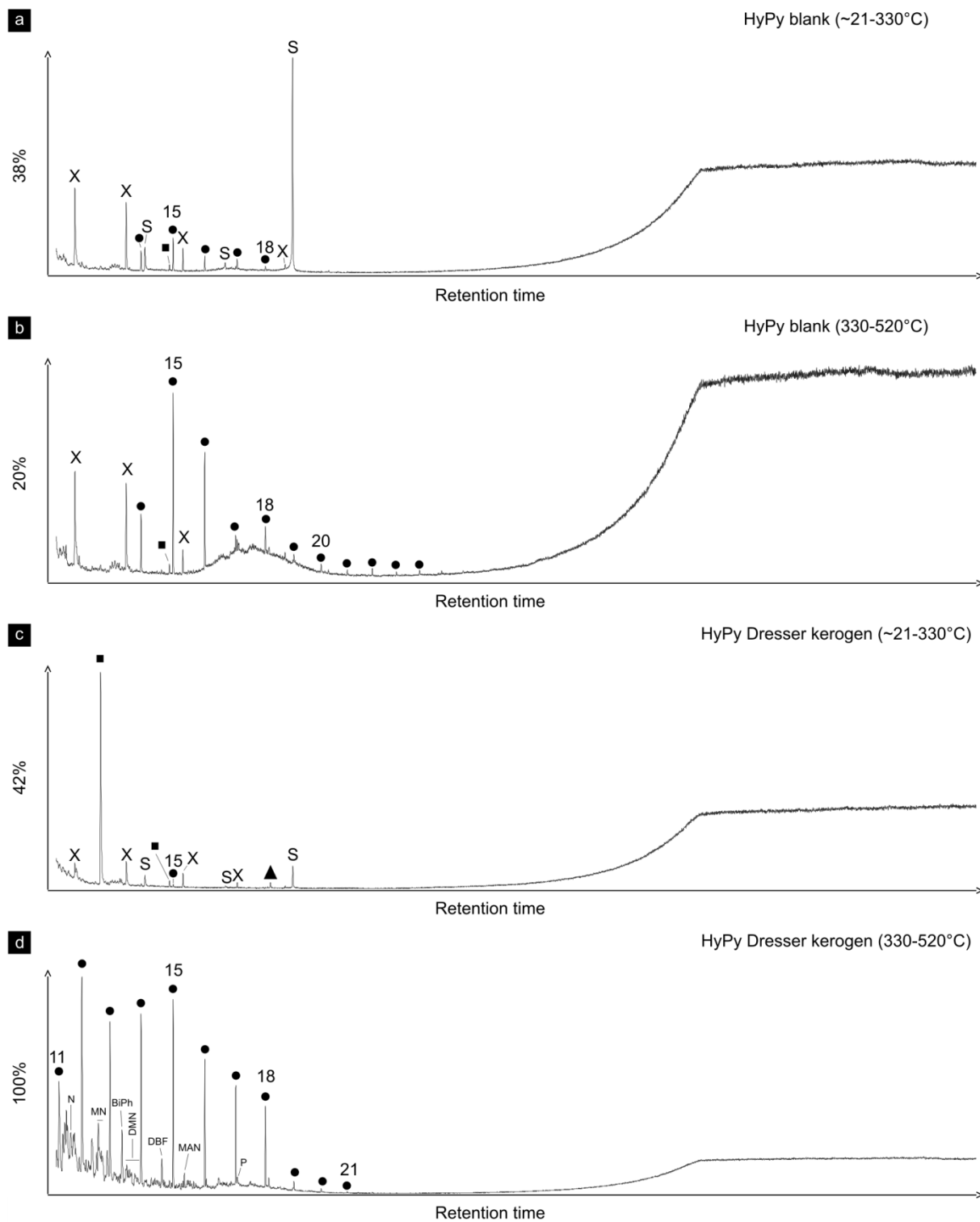
**Jan-Peter Duda et al.**

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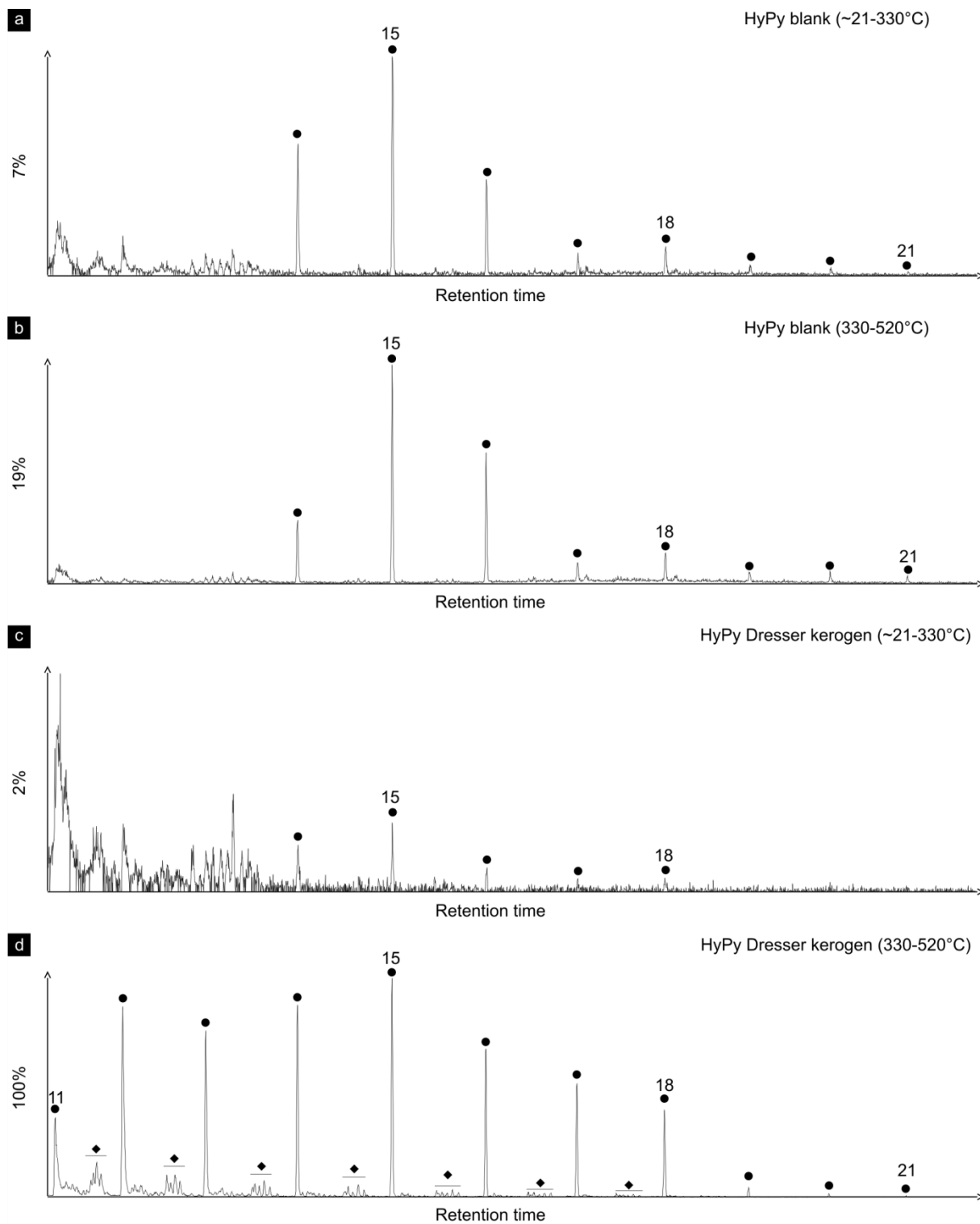


**Fig. S1.** Hydrothermal chert veins of the ca. 3.5 Ga Dresser Formation (Pilbara Craton, Western Australia). (a) Hydrothermal chert veins of the Dresser Formation (ridges, see arrows) forming large-scale networks in their host basalts. (b) Hydrothermally altered footwall basalts exhibiting pillow structures (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).



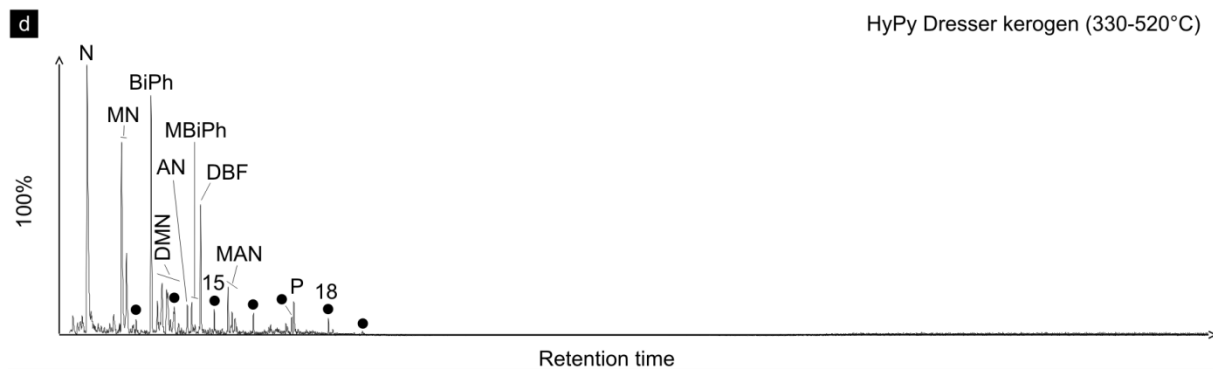
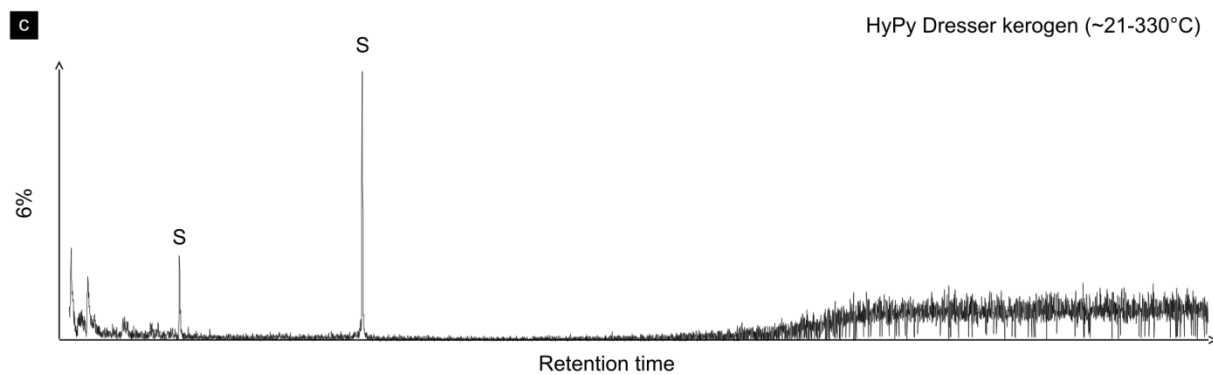
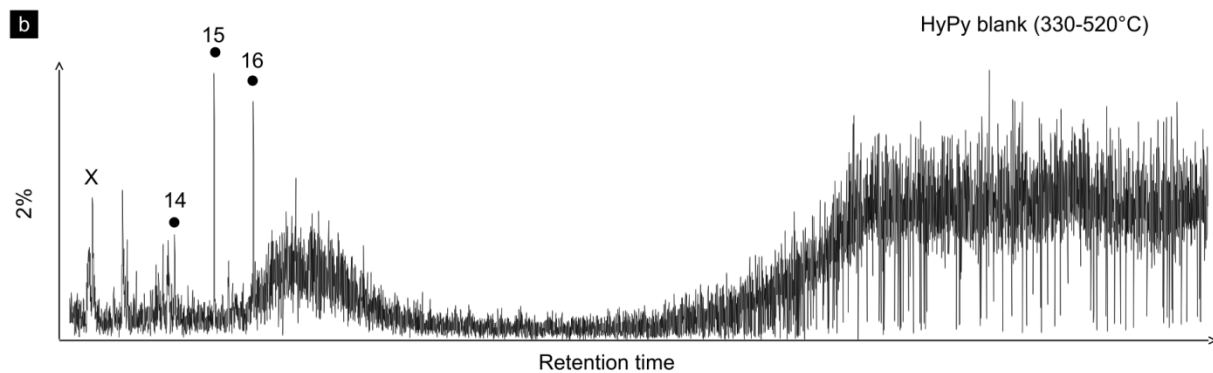
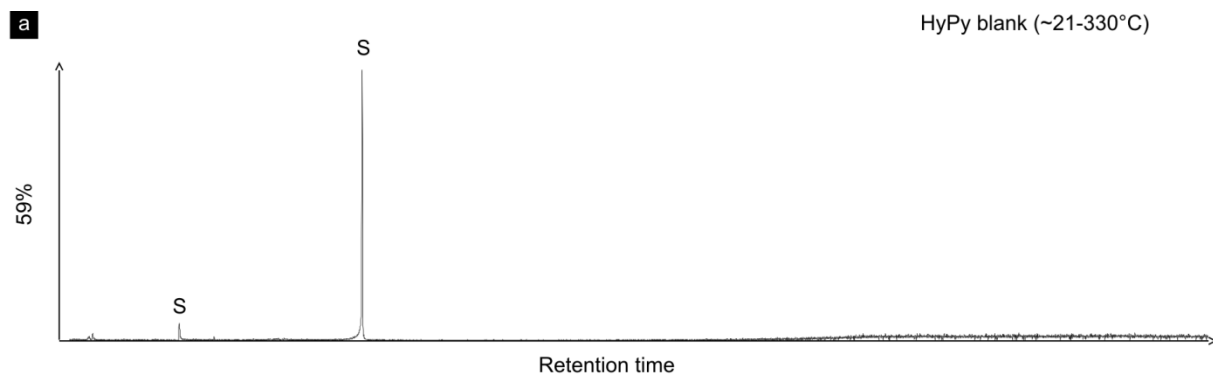
**Fig. S2.** Total ion current chromatograms. Low-temperature (**a**) and high-temperature (**b**) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (**c**) and high-temperature (**d**) HyPy products of the Dresser kerogen. Compounds 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).

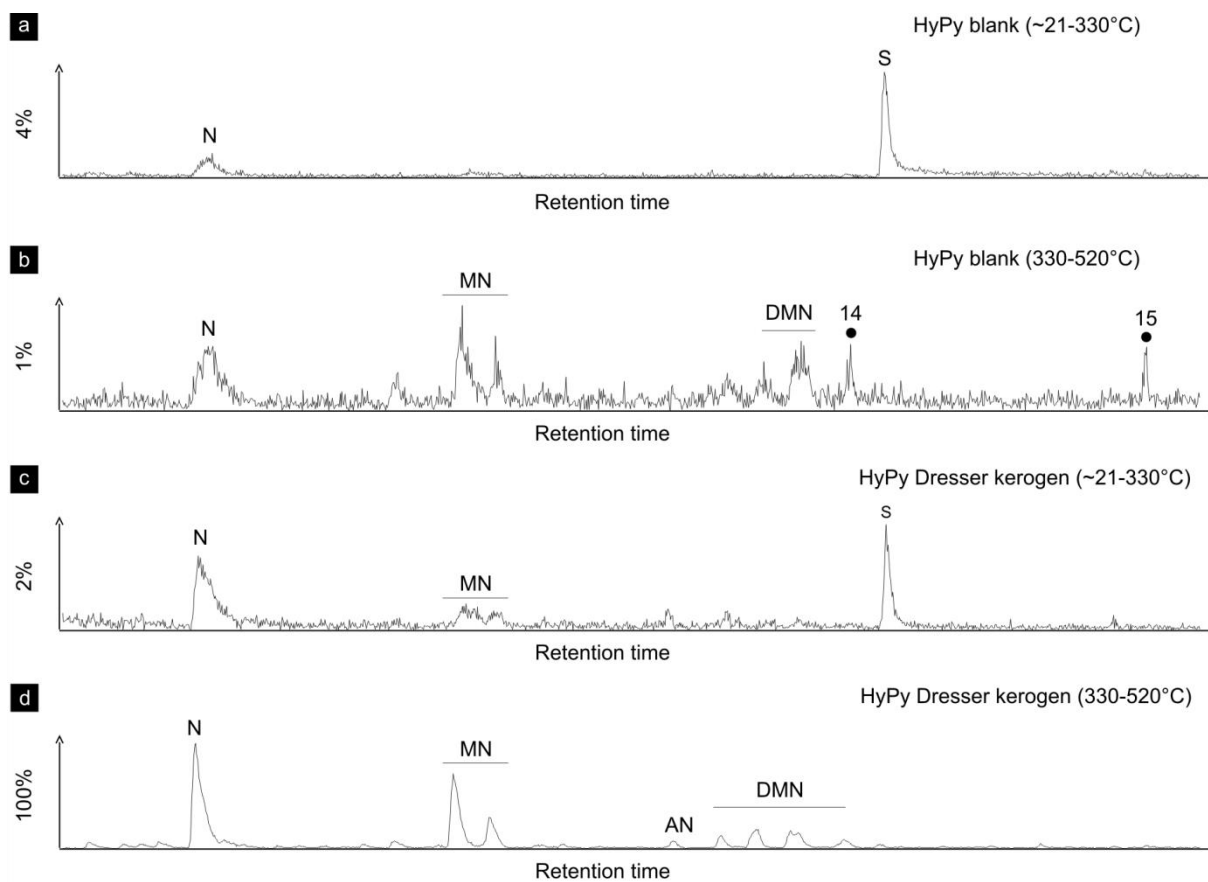
Note: Percentage values given on the vertical axes of chromatograms (**a–c**) relate peak intensities to chromatogram (**d**) (HyPy Dresser kerogen, 330–520°C).



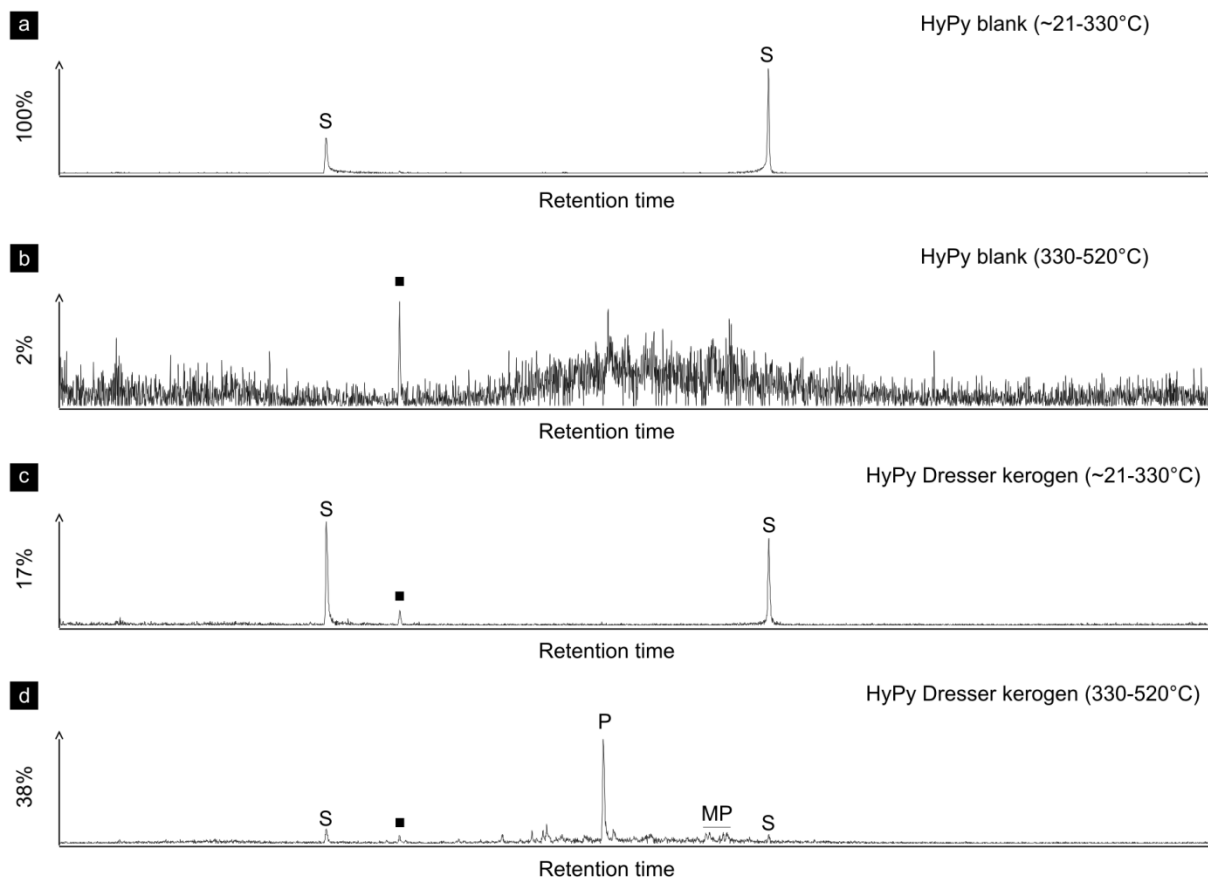
**Fig. S4.** Ion chromatograms selective for aromatic hydrocarbons ( $m/z$  128, 142, 154, 156, 168, 178). Low-temperature (**a**) and high-temperature (**b**) HyPy products of analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (**c**) and high-temperature (**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: methylacenaphthenes; 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).



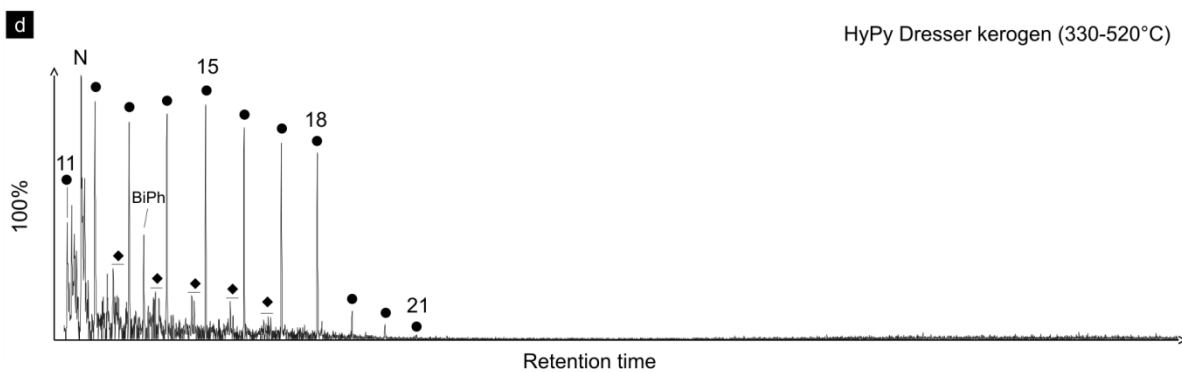
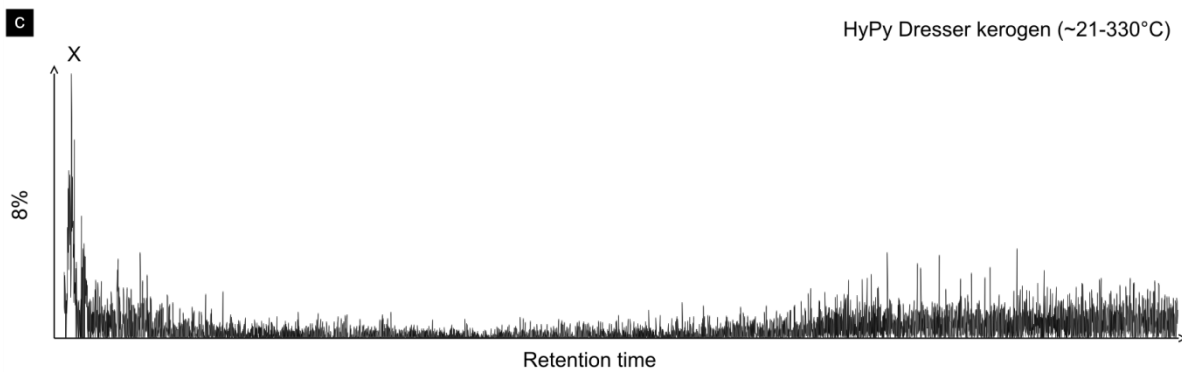
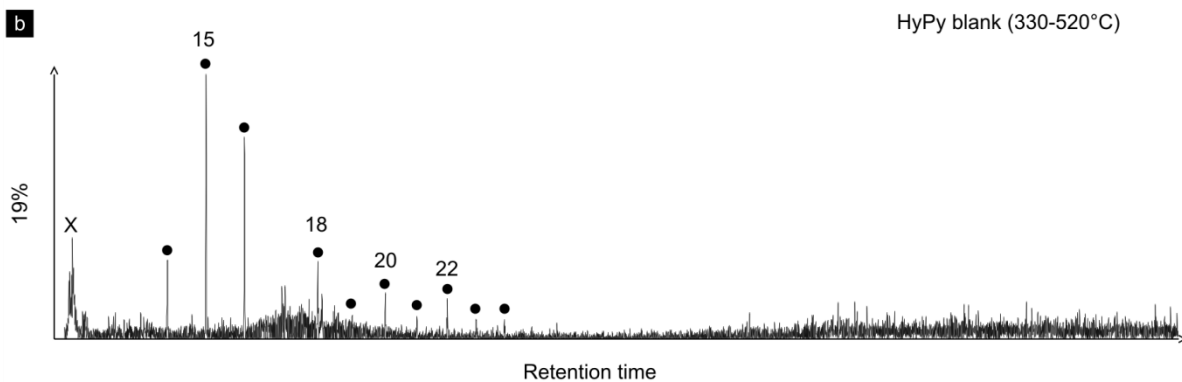
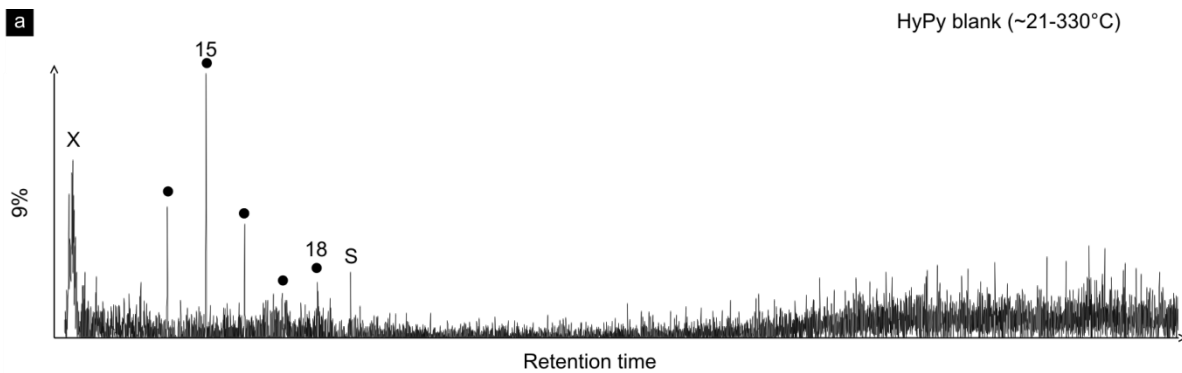


**Fig. S5.** Partial ion chromatograms selective for (dimethyl-, methyl-)naphthalenes ( $m/z$  128, 142, 156). Low-temperature (a) and high-temperature (b) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products of the Dresser kerogen. High-temperature HyPy of the Dresser kerogen yielded naphthalene (N), methyl-naphthalenes (MN), dimethyl-naphthalenes (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).



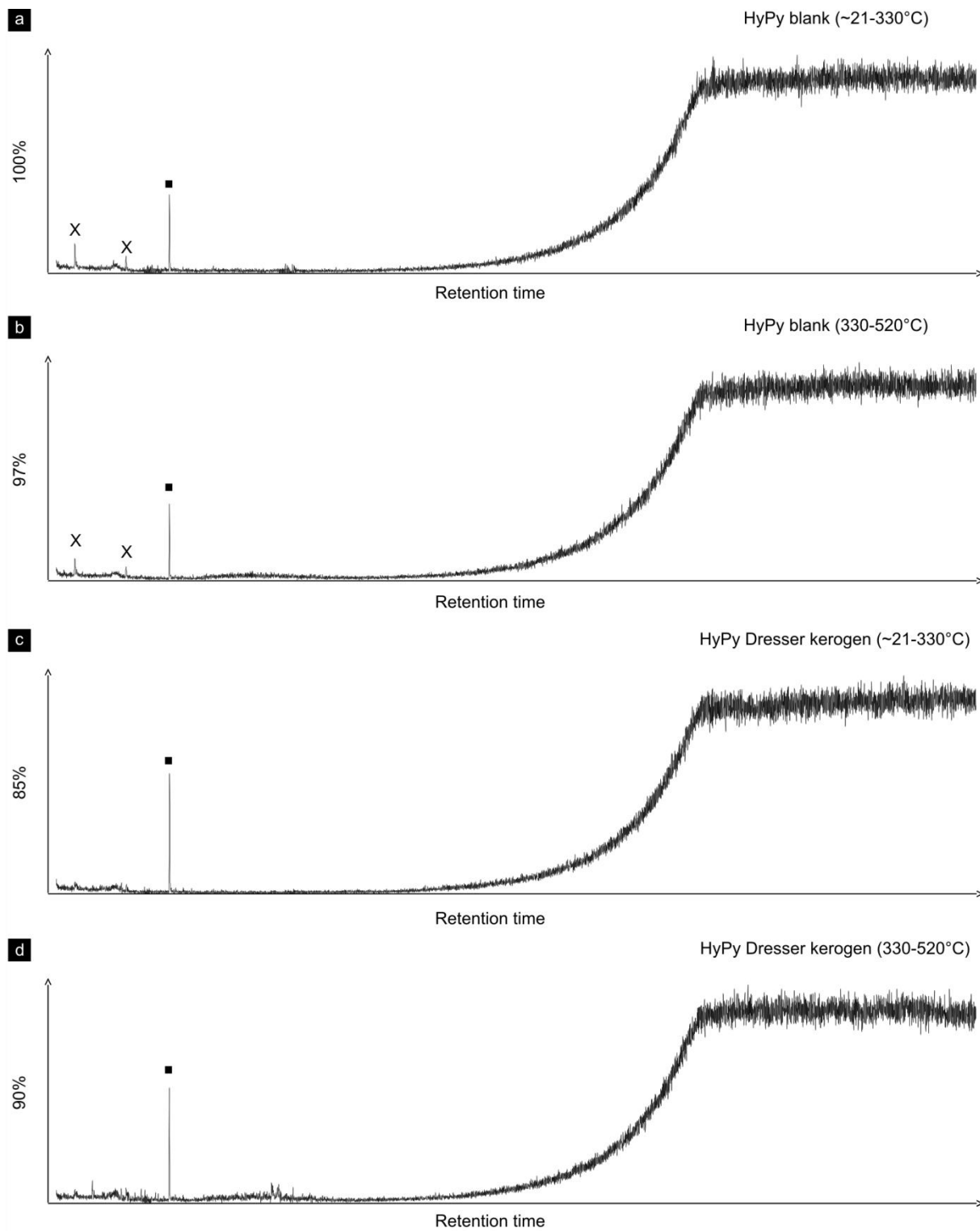
**Fig. S6.** Partial ion chromatograms selective for (methyl-)phenanthrenes ( $m/z$  178, 192). Low-temperature (a) and high-temperature (b) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (c) and high-temperature (d) HyPy products 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).



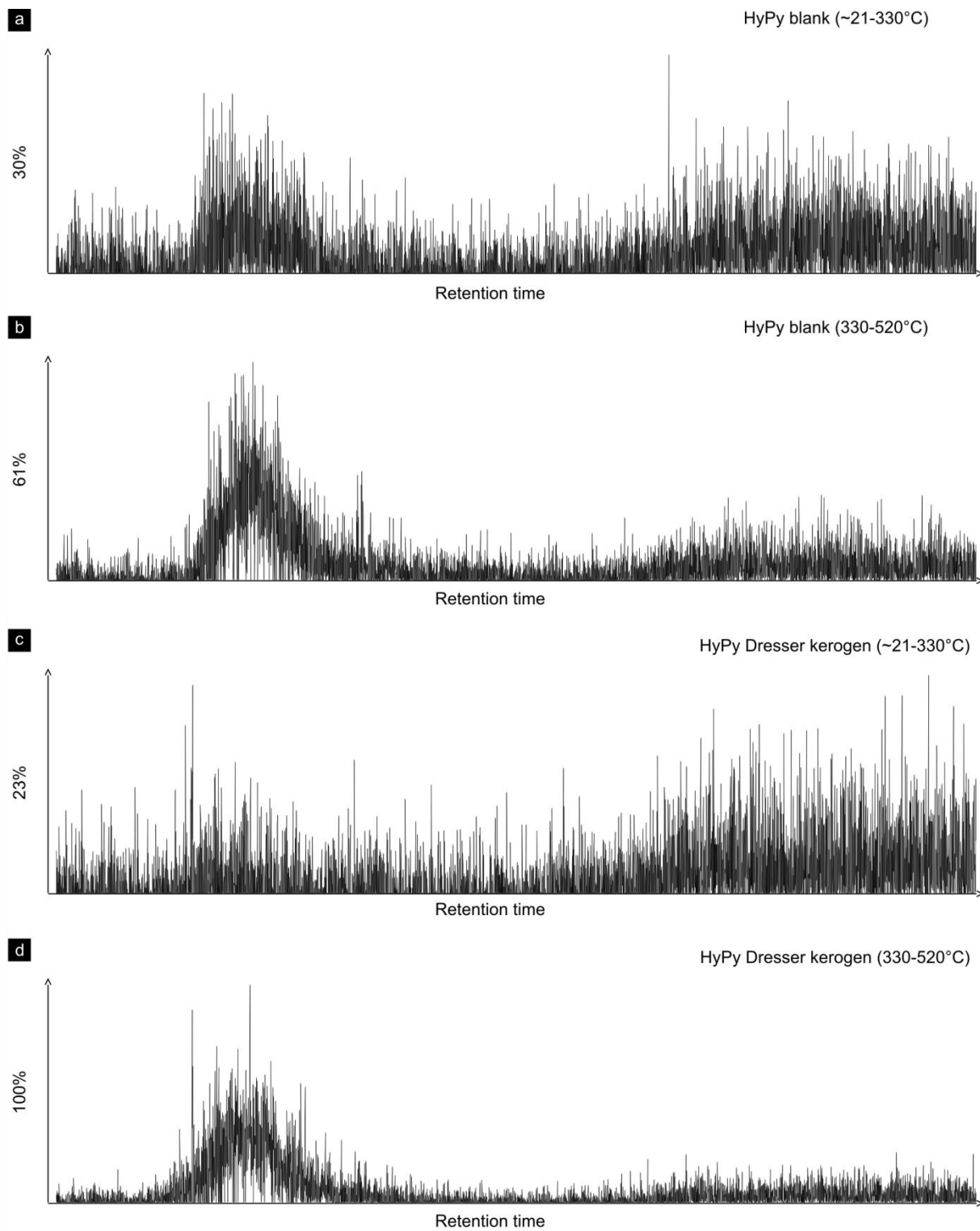
**Fig. S7.** Ion chromatograms selective for branched alkanes with quaternary carbon centres (BAQCs;  $m/z$  127). Low-temperature (**a**) and high-temperature (**b**) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (**c**) and 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  
5 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.

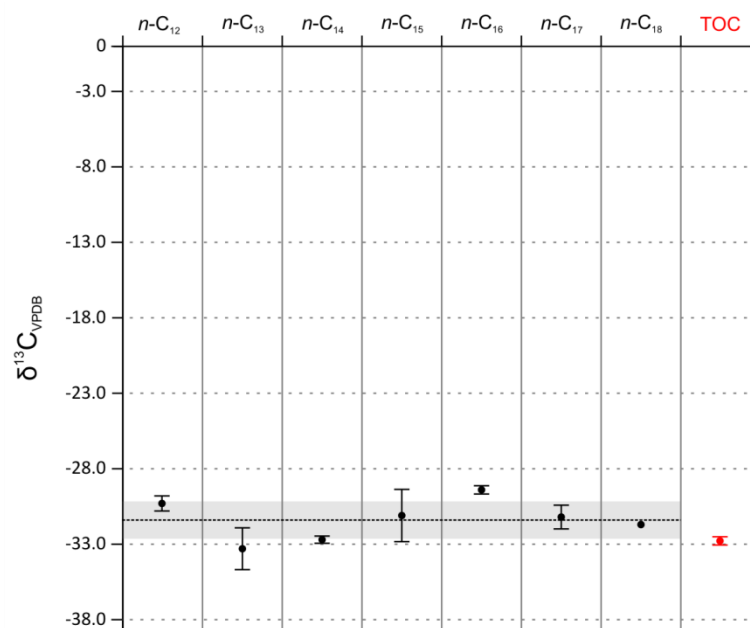
Note: Percentage values given on the vertical axes of chromatograms (**c–d**) relate peak intensities to chromatogram (**a**) (HyPy blank, ~21–330°C).



**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.

- 5 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 ( $\delta^{13}\text{C}$ ) 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).

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