Supplement of Biogeosciences, 15, 1535–1548, 2018
https://doi.org/10.5194/bg-15-1535-2018-supplement

Biogeosciences Open Access EGU

Supplement of

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

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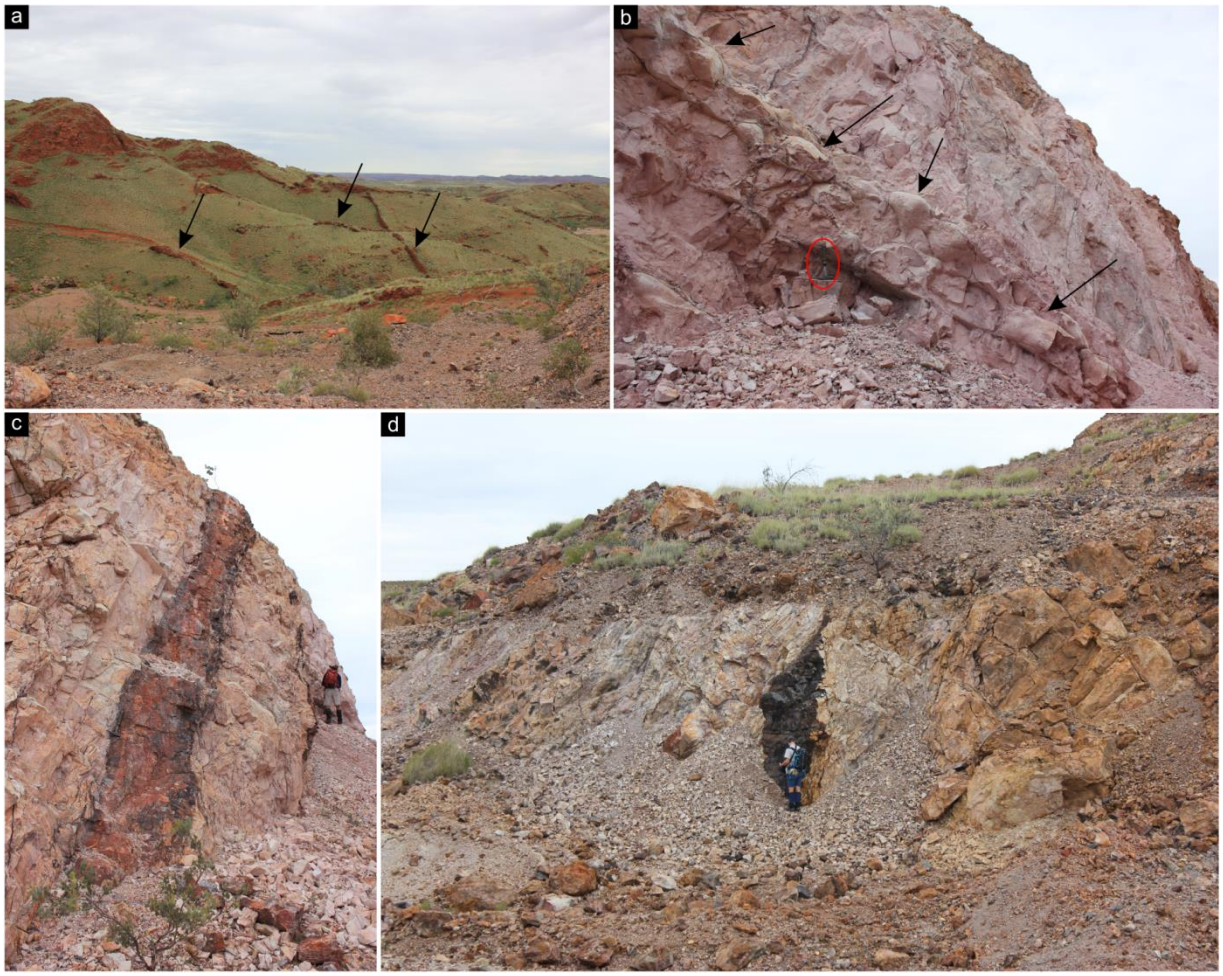

Fig. S1. Hydrothermal chert veins of the ca. 3.5 Ga Dresser Formation (Pilbara Craton, Western Australia). (**a**) Hydrothermal chert veins of the Dresser Formation (ridges, see arrows) forming large-scale networks in their host basalts. (**b**) Hydrothermally altered footwall basalts exhibiting pillow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

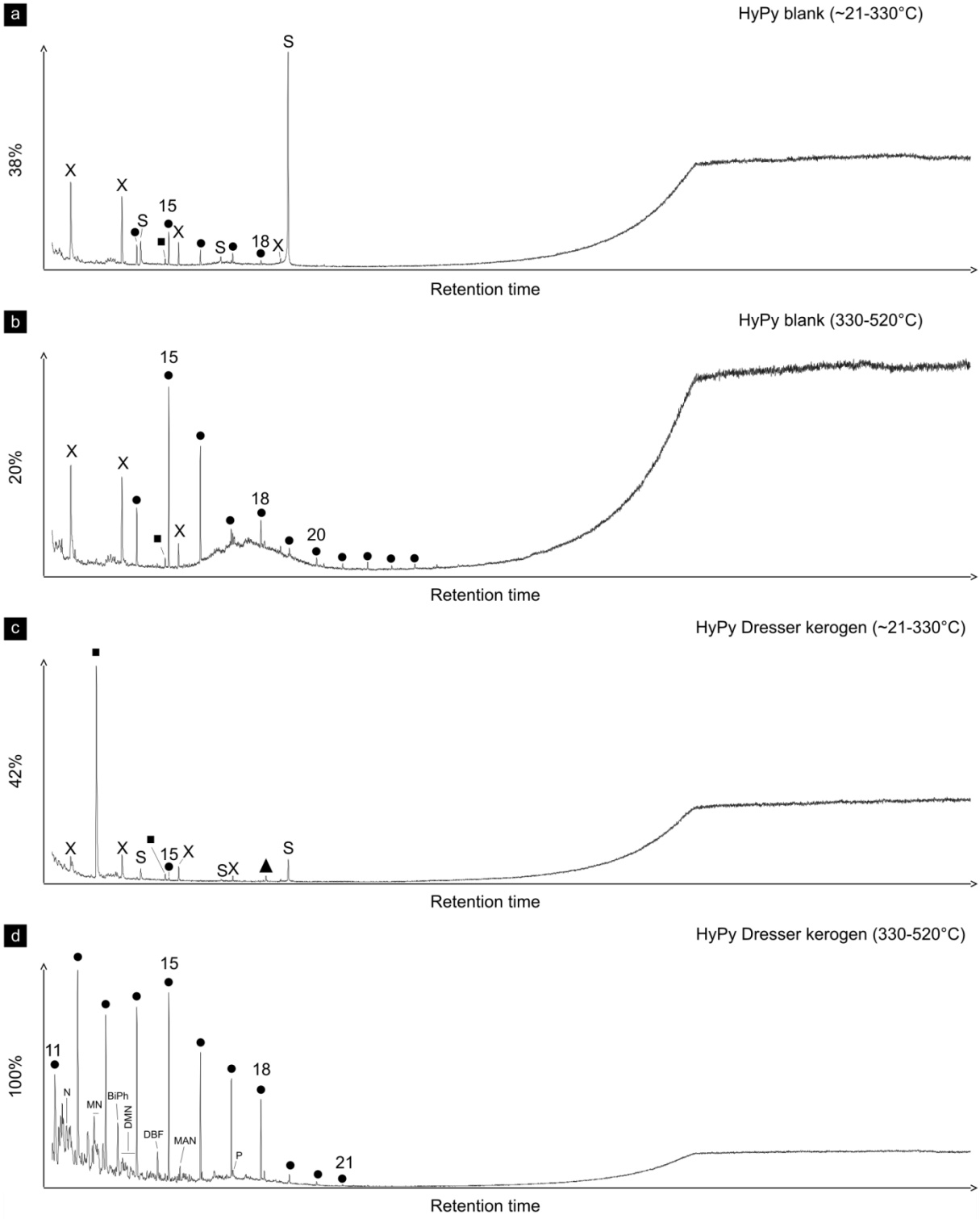
a
HyPy blank (~21-330°C)
38%
X
X
S
15
X
S
18
X
S
Retention time
b
HyPy blank (330-520°C)
20%
15
X
X
18
X
20
Retention time
c
HyPy Dresser kerogen (~21-330°C)
42%
X
X
S
15
X
SX
S
Retention time
d
HyPy Dresser kerogen (330-520°C)
100%
11
15
18
N
MN
BiPh
DMN
DBF
MAN
P
21
Retention time

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).

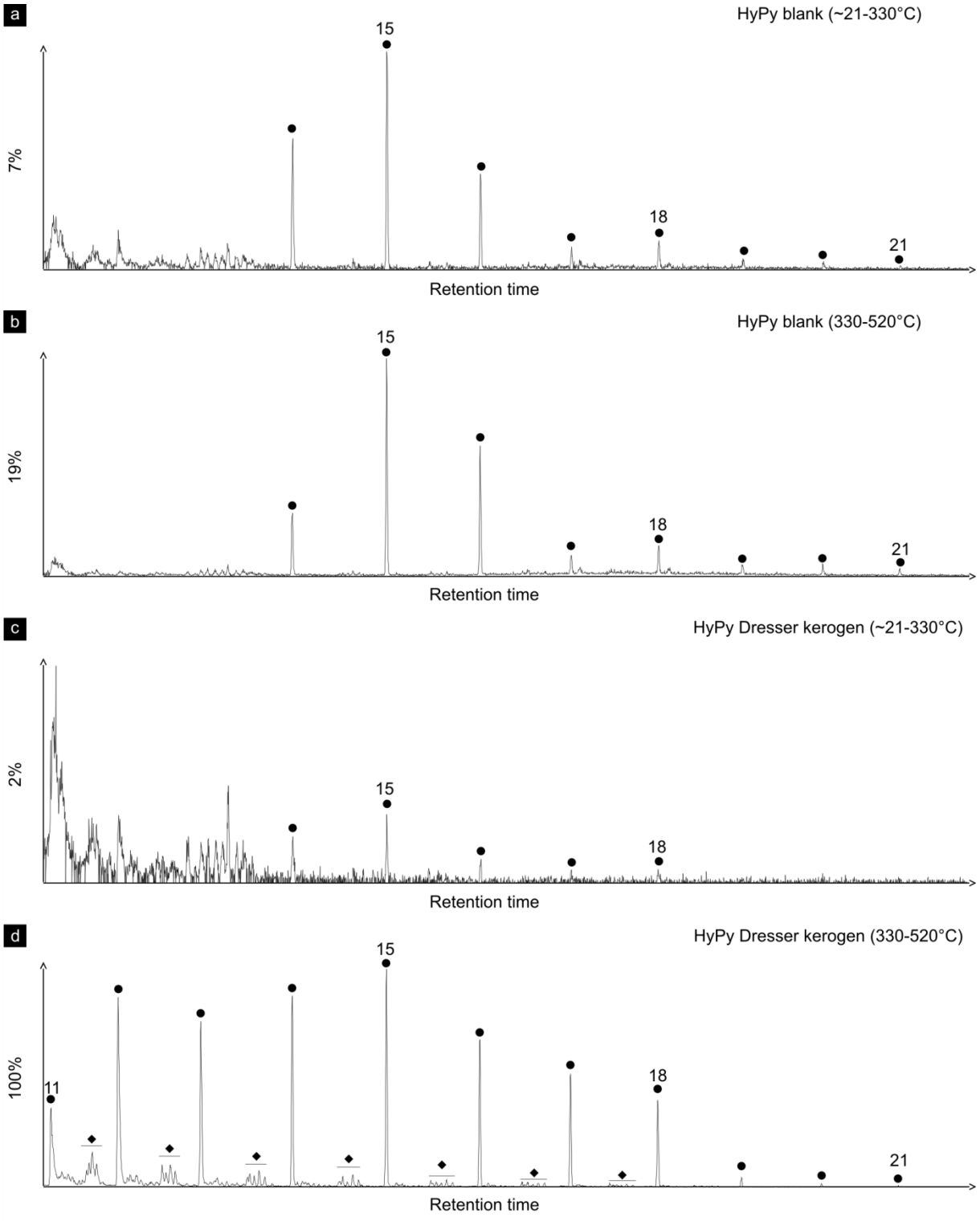
a
HyPy blank (~21-330°C)
7%
15
18
21
Retention time
b
HyPy blank (330-520°C)
19%
15
18
21
Retention time
c
HyPy Dresser kerogen (~21-330°C)
2%
15
18
Retention time
d
HyPy Dresser kerogen (330-520°C)
100%
11
15
18
21
Retention time

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).

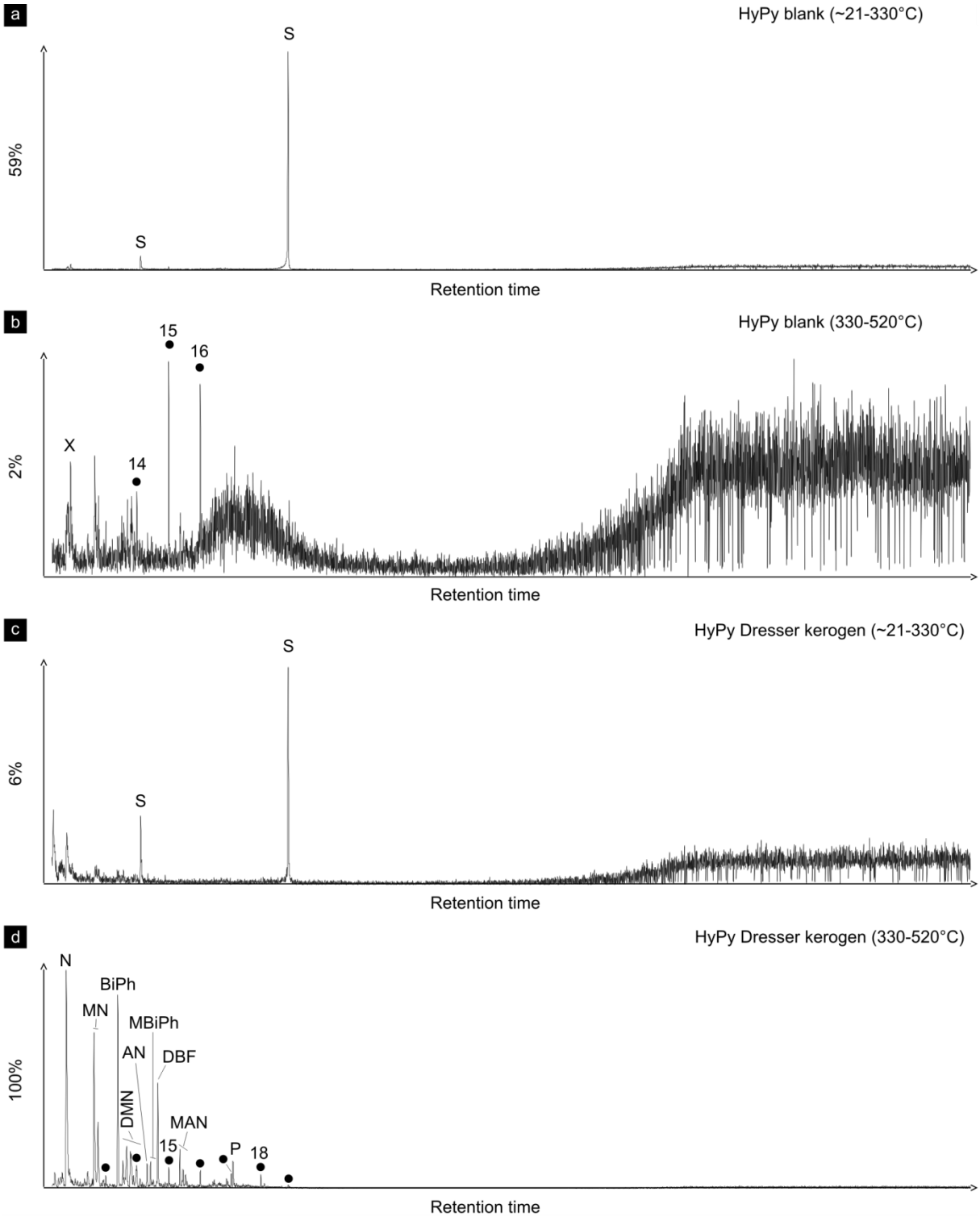
a
HyPy blank (~21-330°C)
S
59%
S
Retention time
b
HyPy blank (330-520°C)
15
16
X
14
2%
Retention time
c
HyPy Dresser kerogen (~21-330°C)
S
6%
S
Retention time
d
HyPy Dresser kerogen (330-520°C)
N
BiPh
MN
MBiPh
AN
DBF
DMN
MAN
15
P
18
100%
Retention time

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).

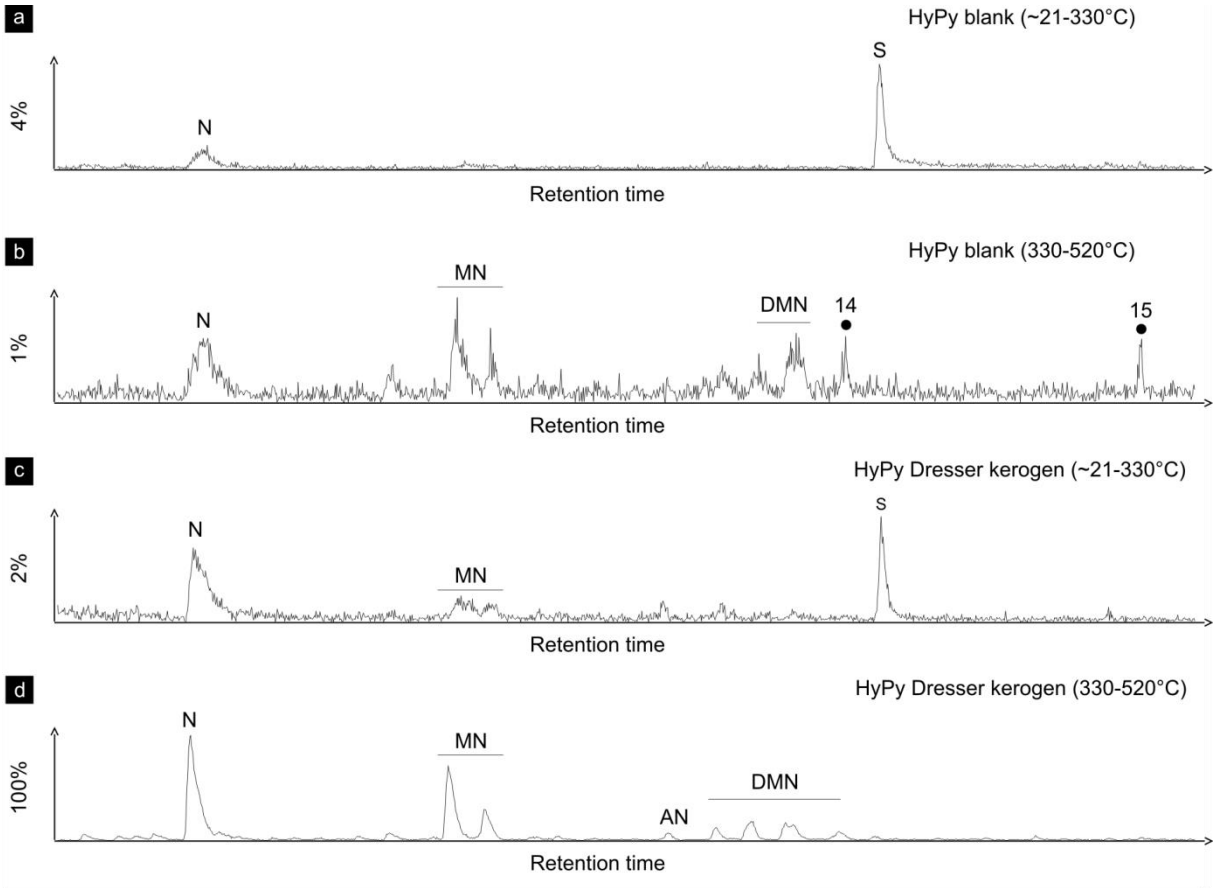

Fig. S5. Partial ion chromatograms selective for (dimethyl-, methyl-)naphthalenes (*m*/*z* 128, 142, 156). Low-temperature (**a**) and high-temperature (**b**) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (**c**) and high-temperature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

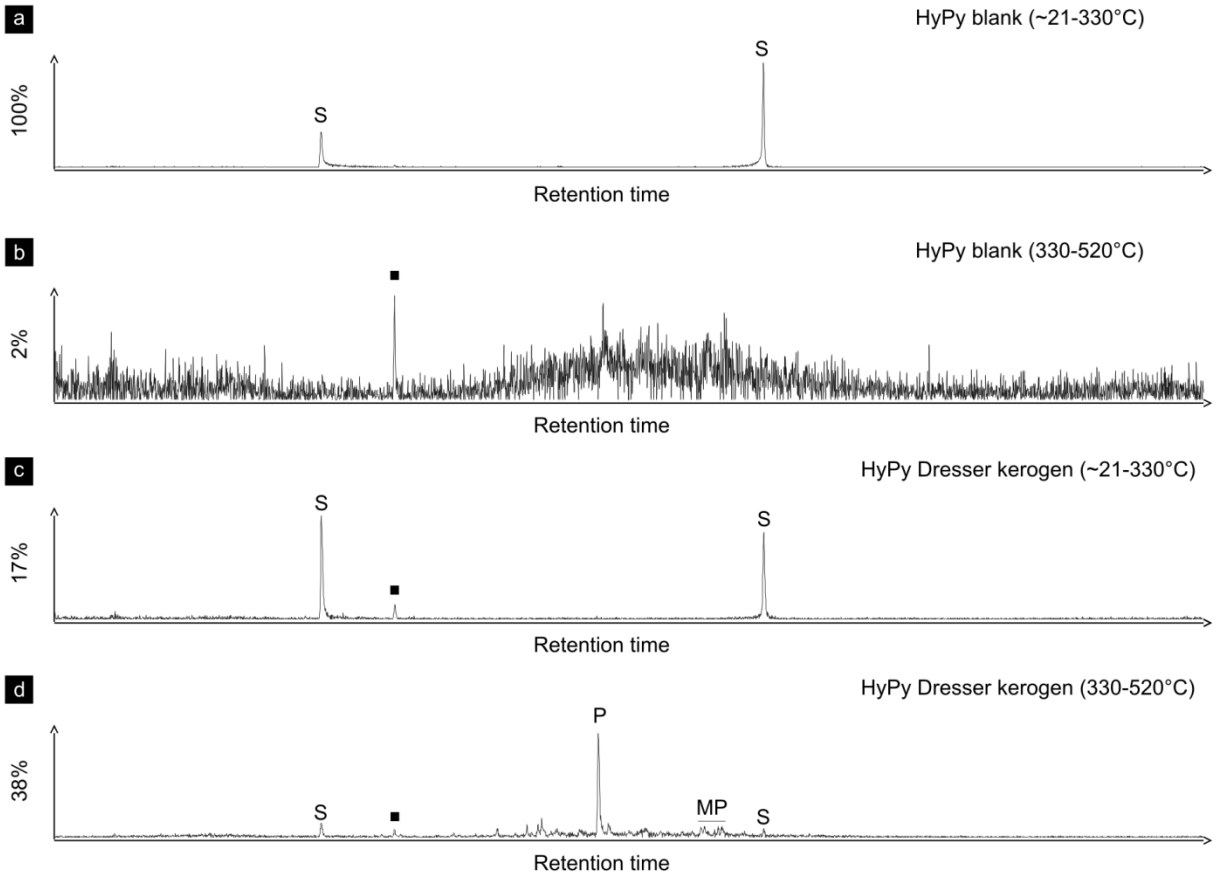

Fig. S6. Partial ion chromatograms selective for (methyl-)phenanthrenes (*m/z* 178, 192). Low-temperature (**a**) and high-temperature (**b**) HyPy products of the analytical blank (combusted sea sand) obtained prior to HyPy of the Dresser kerogen. Low-temperature (**c**) and high-temperature (**d**)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

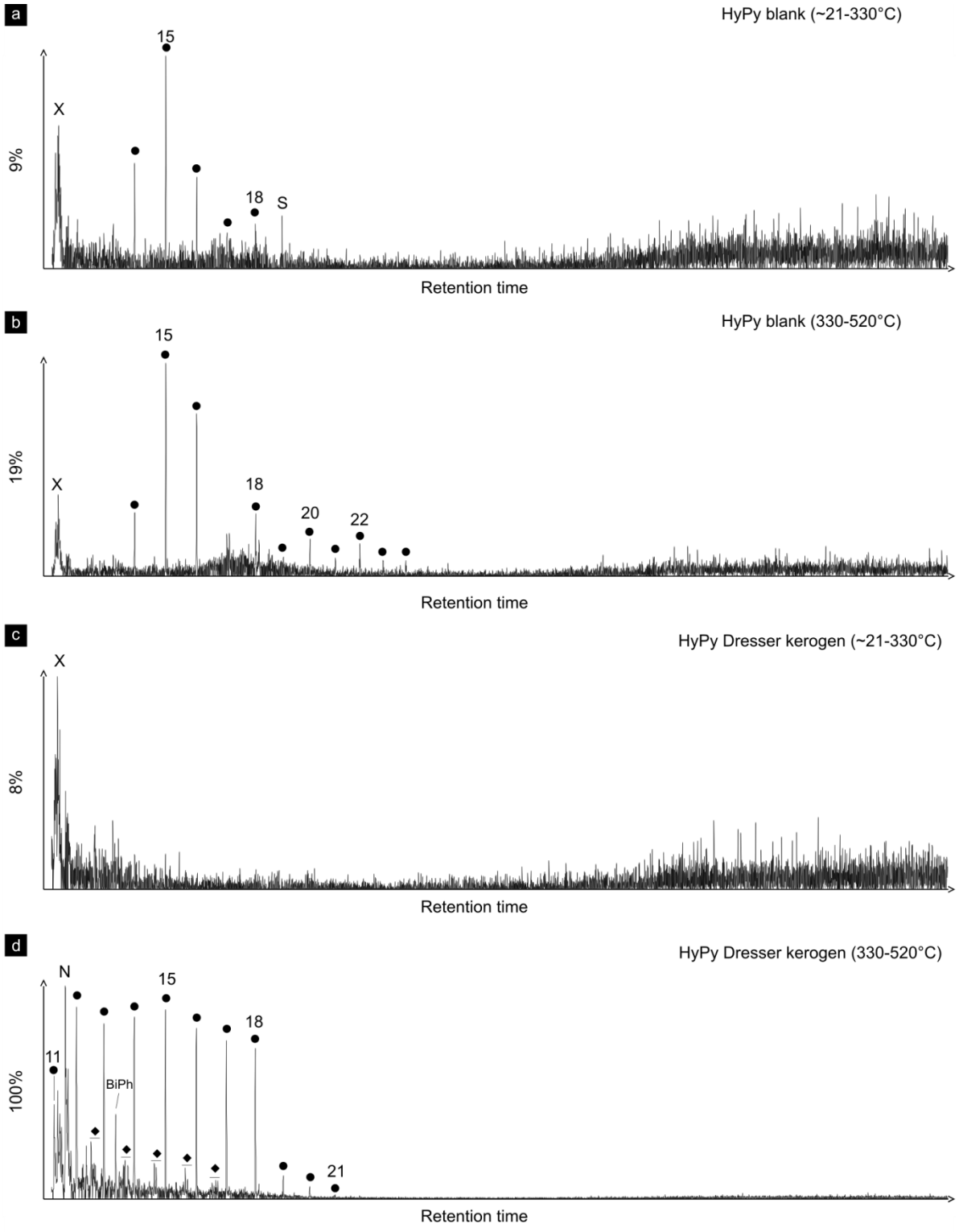
a
HyPy blank (~21-330°C)
15
X
9%
18
S
Retention time
b
HyPy blank (330-520°C)
15
19%
X
18
20
22
Retention time
c
HyPy Dresser kerogen (~21-330°C)
X
8%
Retention time
d
HyPy Dresser kerogen (330-520°C)
N
15
18
11
BiPh
100%
21
Retention time

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).

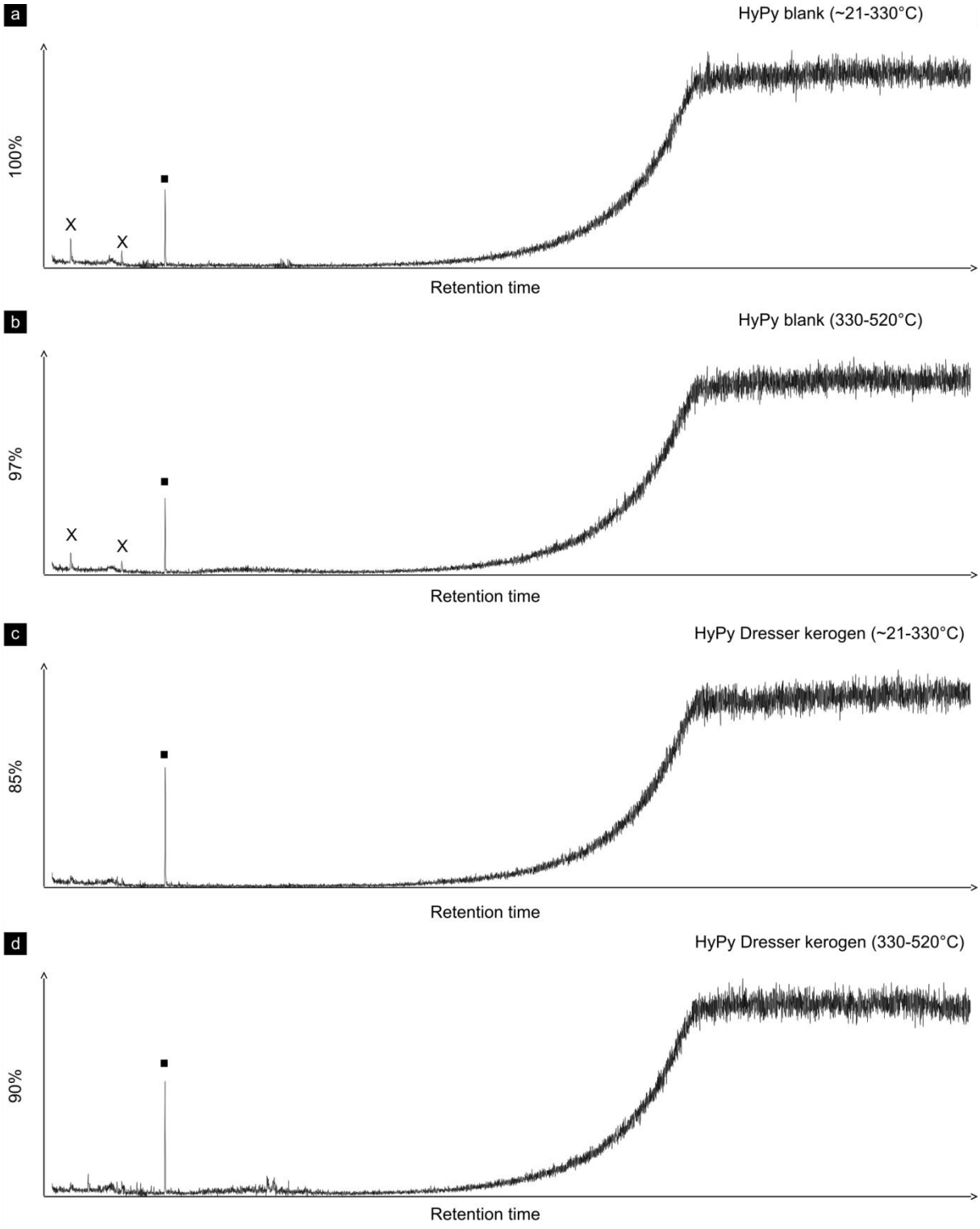
a
HyPy blank (~21-330°C)
100%
X
X
Retention time
b
HyPy blank (330-520°C)
97%
X
X
Retention time
c
HyPy Dresser kerogen (~21-330°C)
85%
Retention time
d
HyPy Dresser kerogen (330-520°C)
90%
Retention time

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).

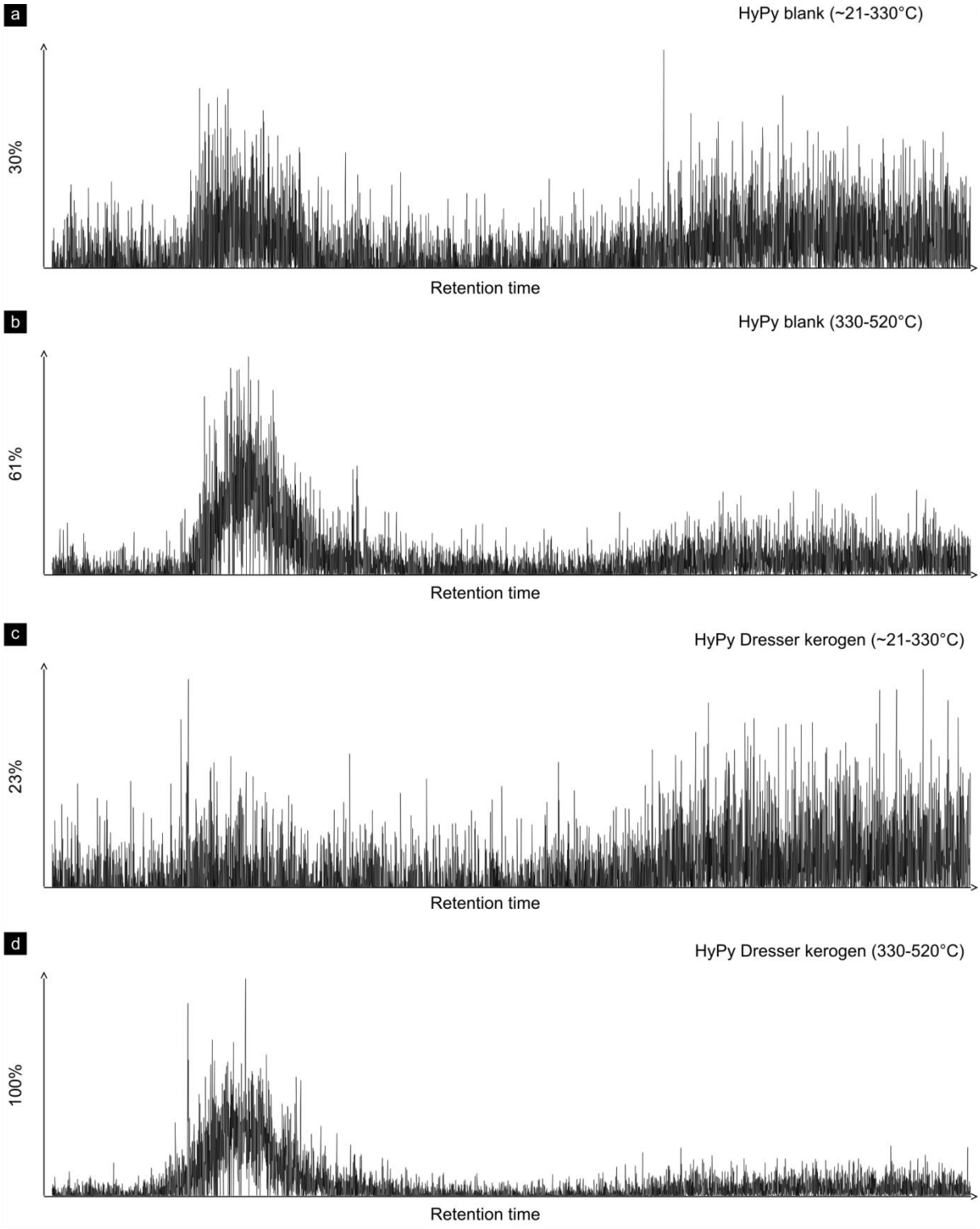
a
HyPy blank (~21-330°C)
30%
Retention time
b
HyPy blank (330-520°C)
61%
Retention time
c
HyPy Dresser kerogen (~21-330°C)
23%
Retention time
d
HyPy Dresser kerogen (330-520°C)
100%
Retention time

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).

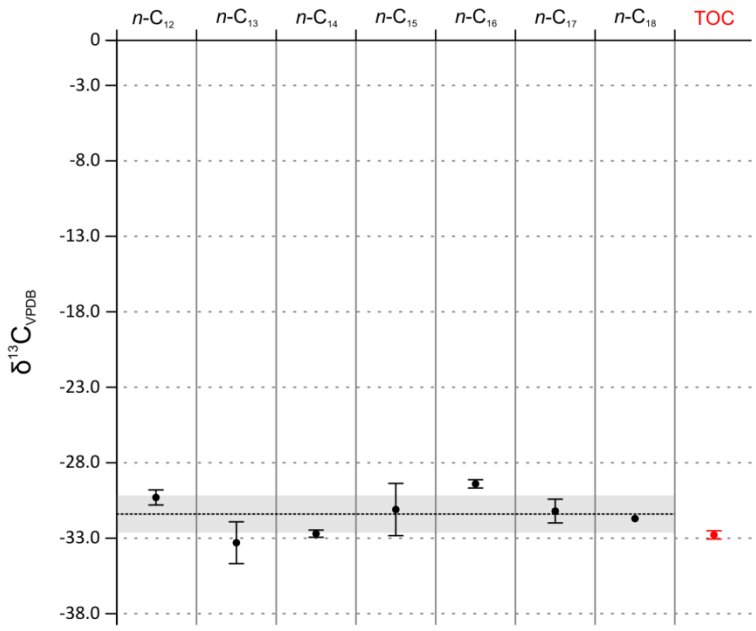

Fig. S10. Stable carbon isotope values ($\delta^{13}C$) of *n*-alkanes released upon high-temperature HyPy and the total organic carbon (TOC). The isotopic similarity indicates that the *n*-alkanes (black dots) were generated from the kerogen (TOC, red dot). Vertical lines: Standard deviations of $\delta^{13}C$ 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 (±1.2 ‰).