

Supplementary Information

Biogeochemical constraints on the origin of methane in an alluvial aquifer: evidence for the upward migration of methane from a coal seam.

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Supplementary Table S1. Groundwater geochemical isotopic data used for determining geochemical potential for methanogenesis and *in-situ* oxidation (* - samples were below the lowest standard).

Sample	Depth interval (m)	$\delta^{13}\text{C-DIC}$ (‰)	$\delta^{13}\text{C-DOC}$ (‰)	$\delta^{18}\text{O-H}_2\text{O}$ (‰)	$\delta^2\text{H-H}_2\text{O}$ (‰)	$\delta^{34}\text{S-SO}_4$ (‰)	$\delta^{18}\text{O-SO}_4$ (‰)
A	46.6-60.3	-12	-26.9	-4.37	-27.8	NA	NA
B	64.9-69.5	-10.2	-28.2	-5.52	-36.2	NA	NA
C	33.9-41.8	-9.9	-27.6	-4.4	-28.7	NA	NA
D	19.5-35.7	-9.6	-27.2	-4.1	-27.1	15.5	10.6
E	23.6-42.5	-11.2	-31.1*	-4.25	-28.4	NA	NA
F	28.6-40.8	-10.1	-30.3	-4.88	-32	NA	NA
G	31.7-35.4	-9.6	-30.2*	-4.97	-32.4	NA	NA
H	25.3-50.3	-13.6	-28.5*	-5.08	-32	14.8	9.7

Supplementary Table S2. Groundwater major ion data used for determining geochemical potential for methanogenesis and *in-situ* oxidation.

Sample	Depth interval (m)	[DO] (mg/L)	[SO ₄ ²⁻] (mg/L)	[NO ₃ ⁻] (mg/L)	[NO ₂ ⁻] (mg/L)
A	46.6-60.3	8.53	7.3	1.20	< 0.05
B	64.9-69.5	4.31	8	1.30	< 0.05
C	33.9-41.8	6.5	3.2	2.30	< 0.05
D	19.5-35.7	6.39	55	2.40	< 0.05
E	23.6-42.5	5.02	3.3	1.40	< 0.05
F	28.6-40.8	7.61	11	1.20	< 0.05
G	31.7-35.4	4.85	8.2	1.40	< 0.05
H	25.3-50.3	0.91	29	2.10	< 0.05

Supplementary Table S3. [CH₄], individual isotopic signature and isotopic source signature data from Iverach et al. (2015) used in discussions on the potential for methanogenesis and *in-situ* oxidation.

Sample	Depth interval (m)	[CH ₄] (ppm)	Individual $\delta^{13}\text{C-CH}_4$ (‰)	Source $\delta^{13}\text{C-CH}_4$ (‰)
A	46.6-60.3	1.585	-46.4	-55.9
B	64.9-69.5	1.813	-47.3	-55.9
C	33.9-41.8	1.813	-47.4	-55.9
D	19.5-35.7	1.673	-46.9	-55.9
E	23.6-42.5	1.703	-45.6	-69.1
F	28.6-40.8	0.889	-38.8	-55.9
G	31.7-35.4	1.705	-45.6	-69.1
H	25.3-50.3	1.709	-45.8	-69.1