Equations for estimating potential CO_2 production from anaerobic CH_4 oxidation or anaerobic respiration

Anaerobic methane oxidation (AMO, adapted from Bhattarai et al. 2019 and Wallenius et al. 2021).

	α (mol CO_2 production mol^{-1} AEA reduction) †
Nitrate (NO_3^-)	
(i) $4NO_3^- + CH_4 \rightarrow 4NO_2^- + CO_2 + 2H_2O$	0.25
(ii) $8NO_3^- + 5CH_4 + 8H^+ \rightarrow 4N_2 + 5CO_2 + 14H_2O$	0.625
Sulfate (SO_4^{2-})	
(iii) $SO_4^{2-} + CH_4 \rightarrow S^{2-} + CO_2 + 2H_2O$	1
Iron [Fe(III)]	
(iv) $8Fe(OH)_3 + CH_4 + 16H^+ \rightarrow 8Fe^{2+} + CO_2 + 22H_2O$	0.125
Manganese [Mn(IV)]	
(v) $4MnO_2 + CH_4 + 12H^+ \rightarrow 4Mn^{2+} + CO_2 + 6H_2O$	0.25

Anaerobic respiration (R_{ana}, adapted from Canfield et al. 1993).

	α (mol CO_2 production mol^{-1} AEA reduction) †
Nitrate (NO_3^-)	
(vi) $4NO_3^- + 2CH_2O \rightarrow 4NO_2^- + 2CO_2 + 2H_2O$	0.5
(vii) $8NO_3^- + 10CH_2O + 8H^+ \rightarrow 4N_2 + 10CO_2 + 14H_2O$	1.25
Sulfate (SO_4^{2-})	
(viii) $SO_4^{2-} + 2CH_2O \rightarrow S^{2-} + 2CO_2 + 2H_2O$	2
Iron [Fe(III)]	
(ix) $8Fe(OH)_3 + 2CH_2O + 16H^+ \rightarrow 8Fe^{2+} + 2CO_2 + 22H_2O$	0.25
Manganese [Mn(IV)]	
(x) $4MnO_2 + 2CH_2O + 8H^+ \rightarrow 4Mn^{2+} + 2CO_2 + 6H_2O$	0.5

†α is the equivalence factor, i.e., mole CO_2 produced per mole of each AEA reduced for either AMO or R_{ana} in Equation 5 in the main text. Note, here we illustrate both the minimum and maximum potential CO_2 production for either partial or complete NO_3^- reduction to NO_2^- or N_2, respectively, for both AMO or R_{ana}, but present only the maximum potential in the main text.

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