S.1. Nernst equation and values used for Pourbaix diagram calculation

Nernst equation: $Eh = Eh^{\circ} + \left(\frac{0.59V}{z_e} log \frac{a_{Ox}}{a_{Red}}\right)$ (2)

Reaction	Eh° [V]	Source
$O_2 + 4H^+ + 4\ e^- \rightarrow 2H_2O$	1.229	(Rumble et al., 2012)
$2H^+ + 2\ e^- \rightarrow H_2$	0	
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	0.767	(Cornell and Schwertmann, 2003)
$Fe(OH)_{3,s} + 3H^+ + e^- \rightarrow Fe^{2+} + 3H_2O$	0.944	
$Fe(OH)_2 + e^- + H^+ \rightarrow Fe^{2+} + H_2O$	0.897	
$Fe(OH)_{3,s} + e^- + H^+ \rightarrow Fe(OH)_{2,s} + H_2O$	0.254	
$NO_3^- + 2H^+ + 2e^- \rightarrow NO_2^- + H_2O$	0.42	(Berks et al., 1995)
$NO_2^- + 2H^+ + e^- \rightarrow NO + H_2O$	0.375	
$2NO + 2H^+ + 2e^- \rightarrow N_2O + H_2O$	1.175	
$N_2O + 2H^+ + 2e^- \rightarrow N_2 + H_2O$	1.355	
$2\ NO_3^-(aq) + 4\ H^+(aq) + 2e^- \rightarrow 2\ NO_2(g) + 2H_2O(l)$	0.8	[1]

1 http://www2.ucdsb.on.ca/tiss/stretton/database/Standard_Reduction_Potentials.htm

S.2. Fe tot concentrations (presented as % of initial)

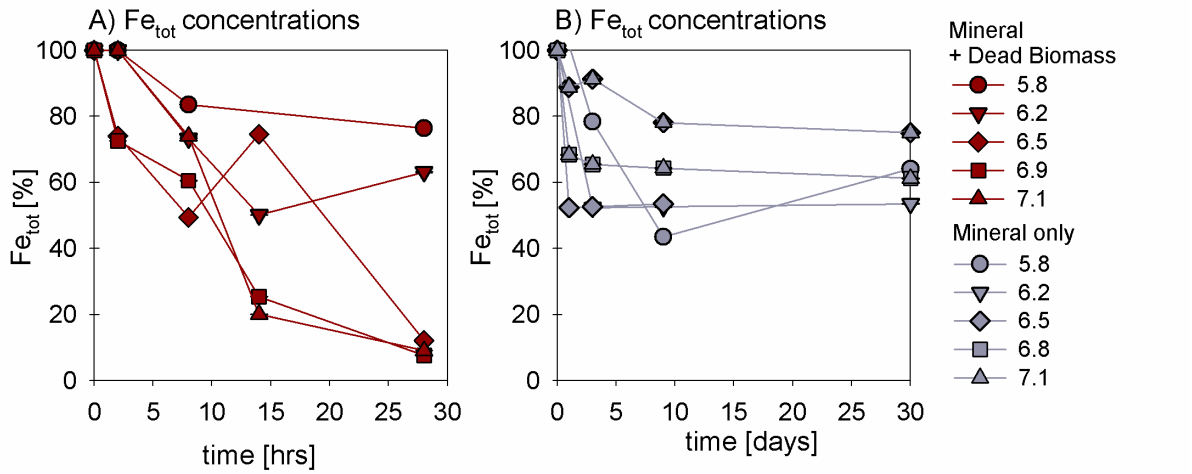

Figure 1: Fe total concentrations for the mineral + dead biomass (A) and the mineral only (B) amended experimental sets obtained from the dissolution of the spun-down pellet in 1 M HCl. Standard error is given as error bars. Fe total values decrease over time, suggesting that the classical ferrozine assay approach applied was insufficient

S.3. 2 mM NO_2^- as threshold value

Klueglein and Kappler (2013) showed that in the presence and absence of goethite, the oxidation of 8 mM Fe(II) was enhanced when ≥2 mM NO_2^- were added. This and the fact that most NDFeO bacteria tend to accumulate up to several mM NO_2^- (Muehe et al., 2009; Weber et al., 2009), which might be a crucial point in order to explain the possible abiotically driven Fe(II) oxidation in NDFeO bacteria, drove our decision to perform our experiments at a threshold of 2 mM Fe(II) and NO_2^-.

S.4. Rayleigh plots for mineral only setups

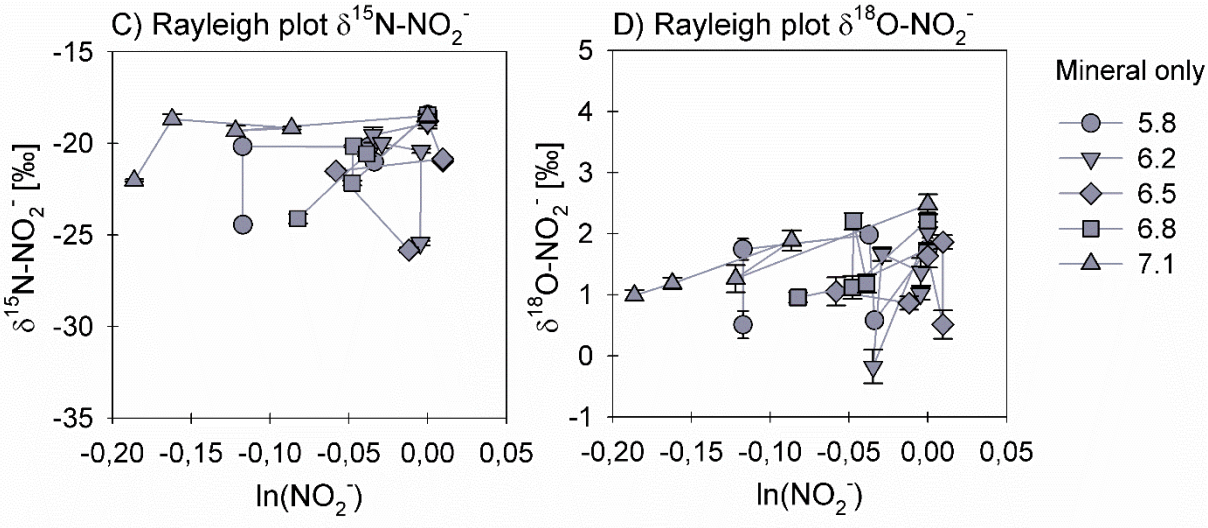

Figure 2: Rayleigh plots for $\delta^{15}N$- (A) and $\delta^{18}O$- (B) NO_2^- values obtained from the mineral-only experiments. Standard error is represented by the error bars. Results obtained do not follow classical Rayleigh fractionation patterns since the concentrations did not decrease significantly over time.

S.5. $\delta^{18}O$ vs $\delta^{15}N^{bulk}$

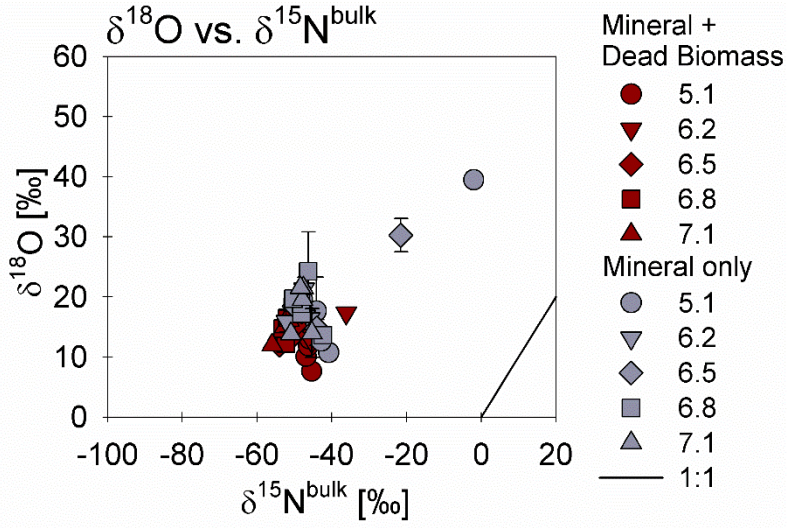

Figure 3: $\delta^{18}O$ vs $\delta^{15}N^{bulk}$ in N_2O combined plot for mineral + dead biomass amended experiments (red) and mineral only experiments (grey). Standard error is represented by the error bars.