Biomass Degradation under Ferruginous Conditions

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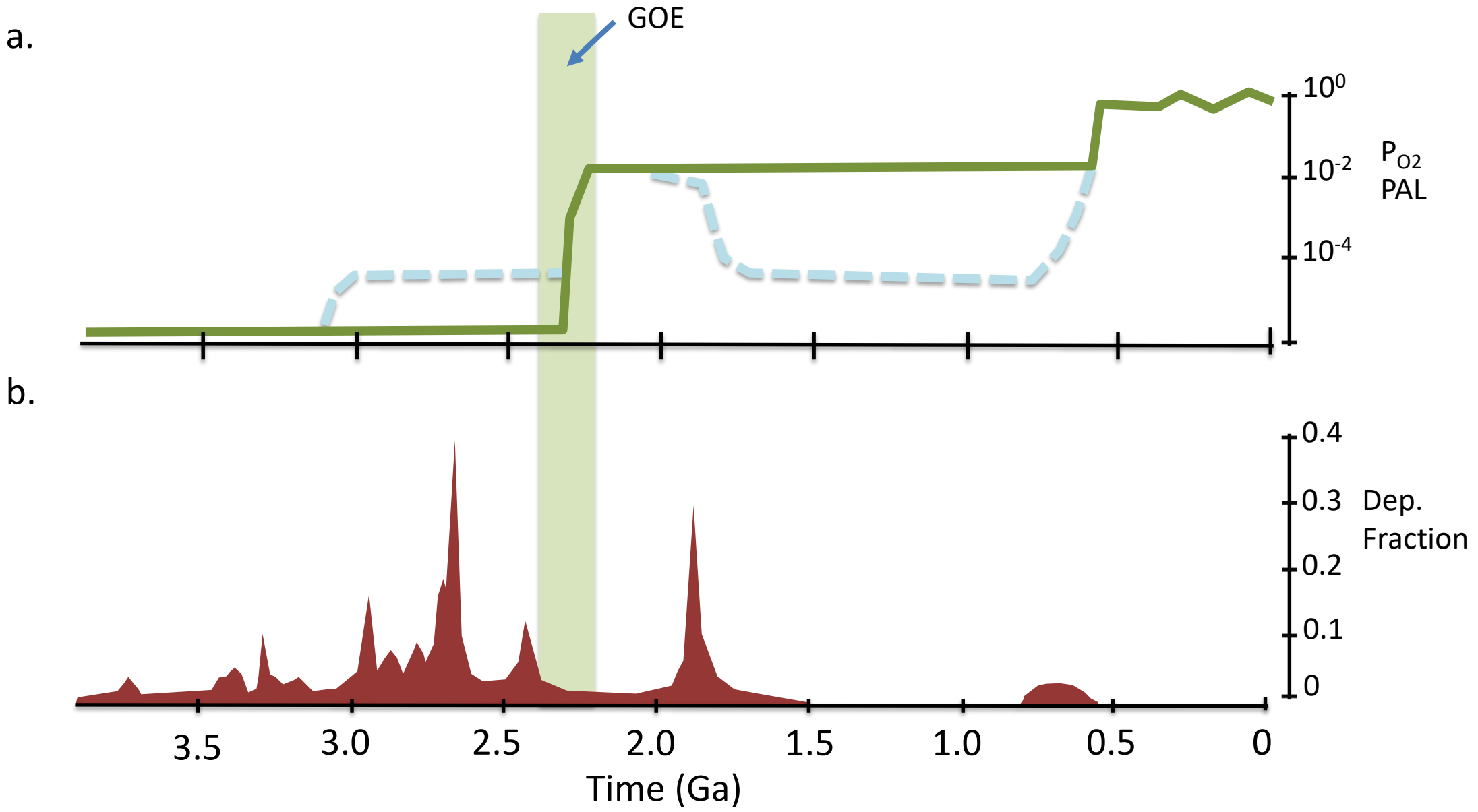
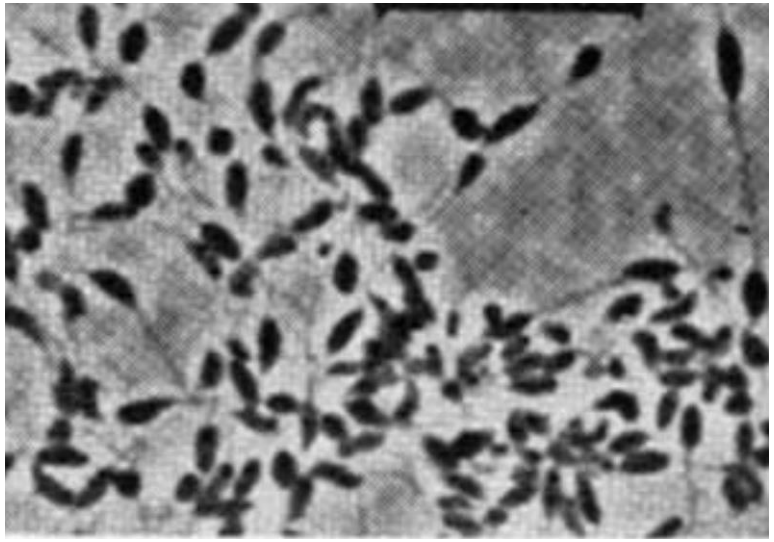
NSERC CRSNG

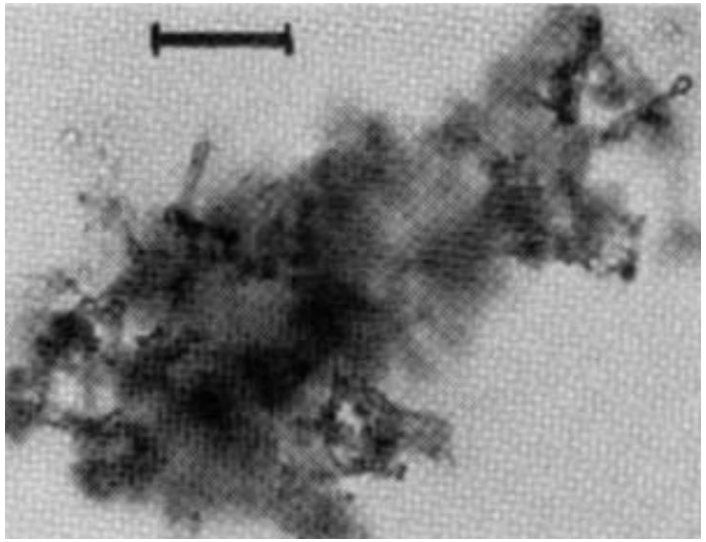
Work Learn

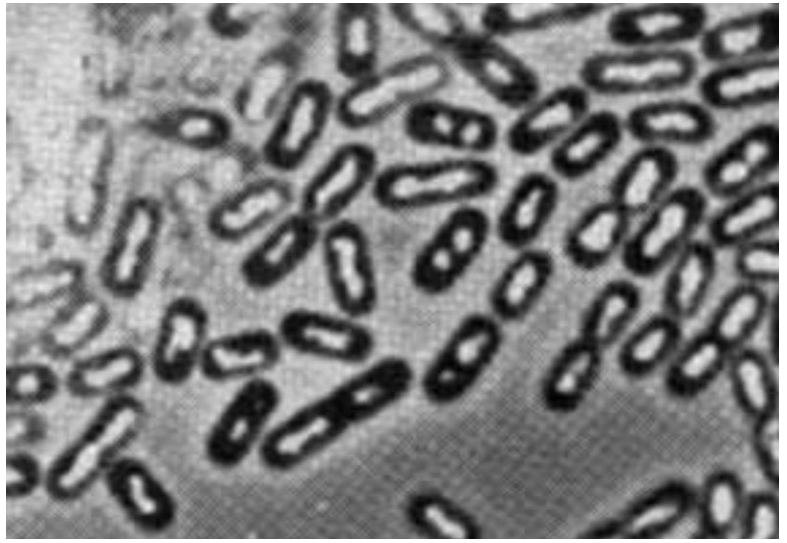
Evolution of Earth's atmosphere and ocean over time



First isolates capable of photoferrotrophy



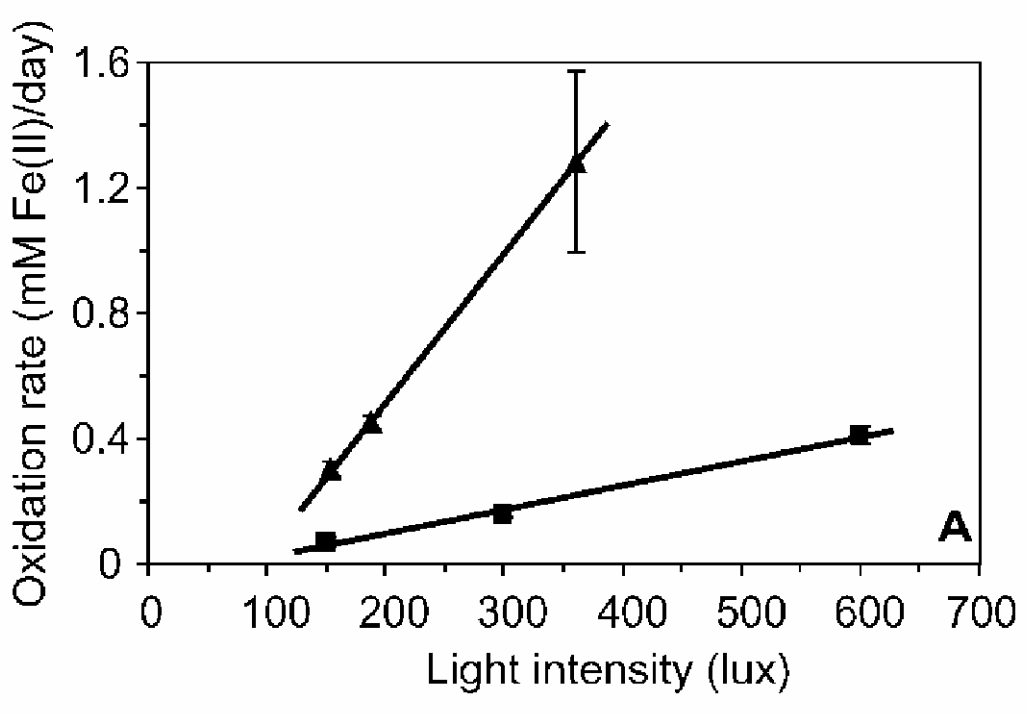


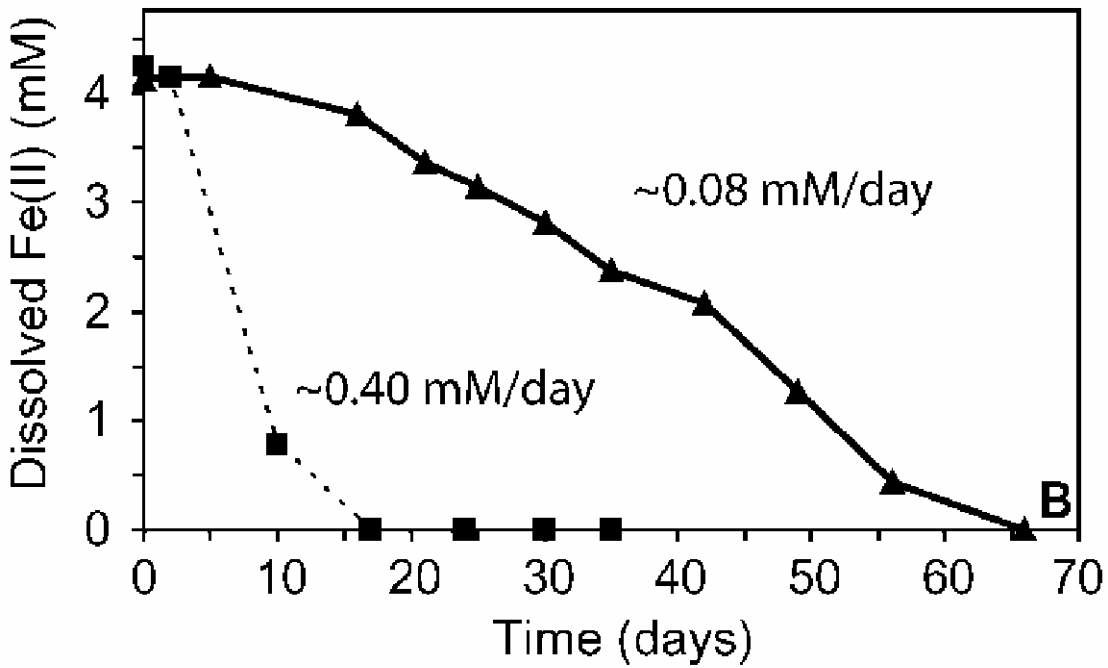


$$HCO_3^- + 4Fe^{2+} + 10H_2O + h\nu \rightarrow [CH_2O] + 4Fe(OH)_3 + 7H^+$$

Widdel et al., Nature, 1993

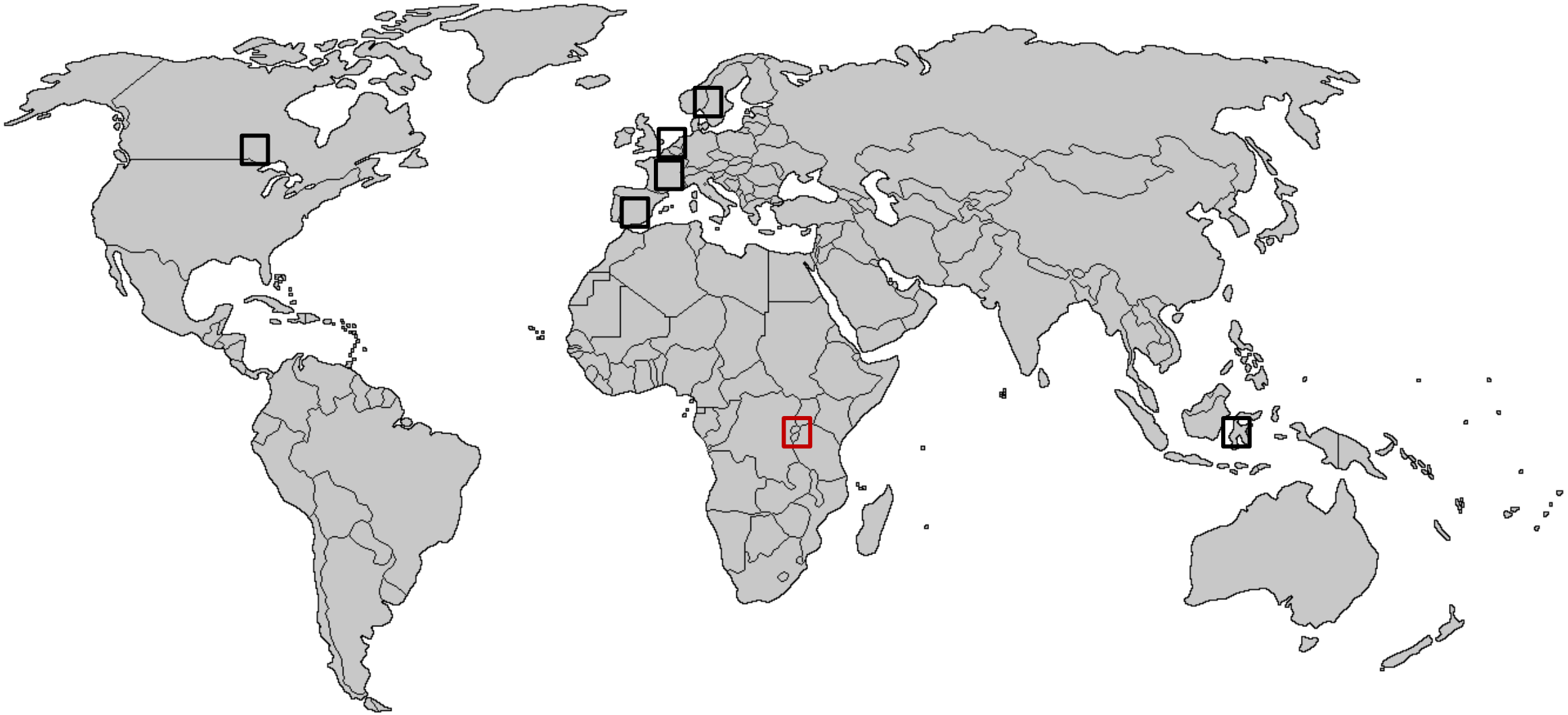
Oxidation rates of pure culture photoferrotrophs



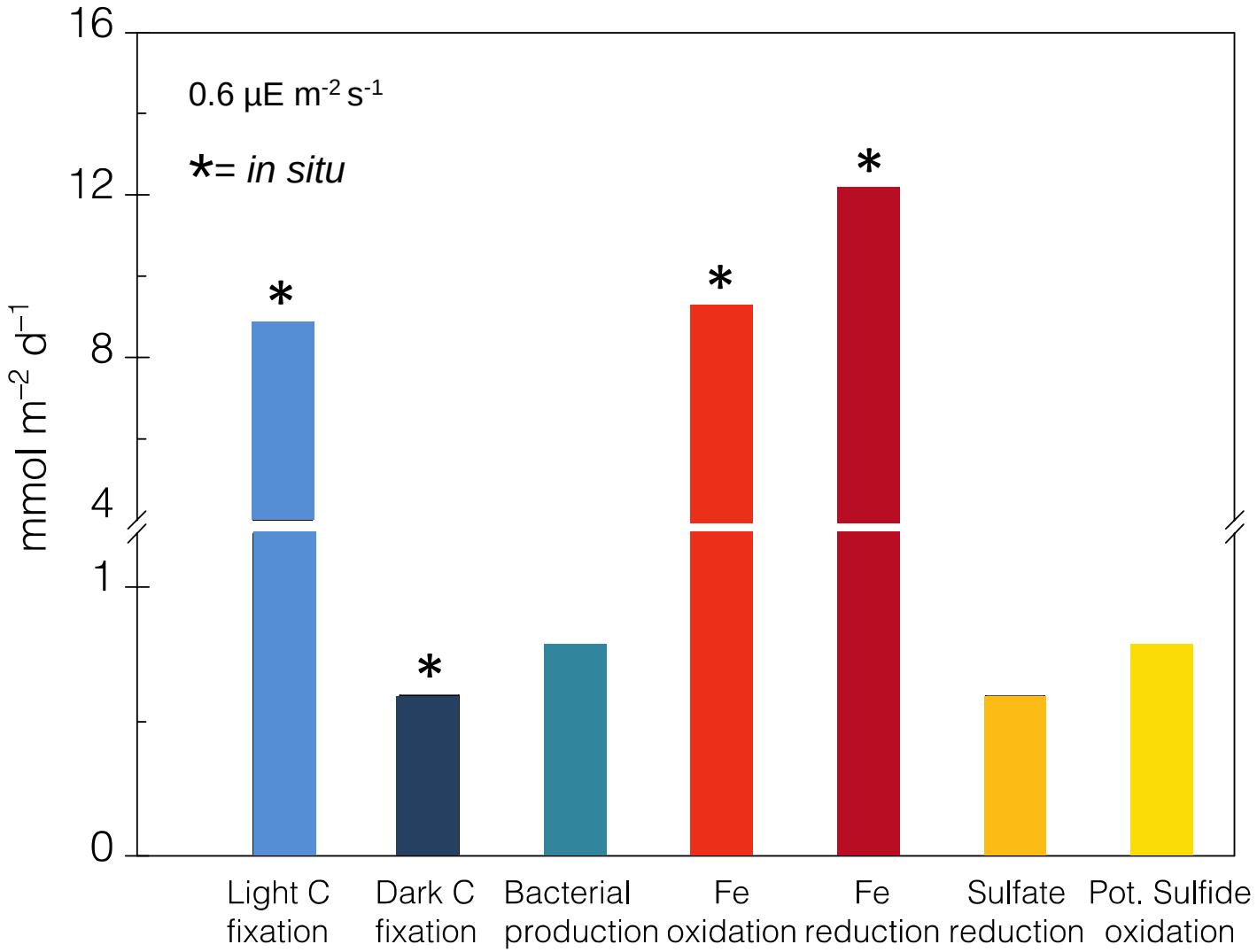


Kappler et al., Geology, 2005

Modern analogues of ferruginous archean oceans

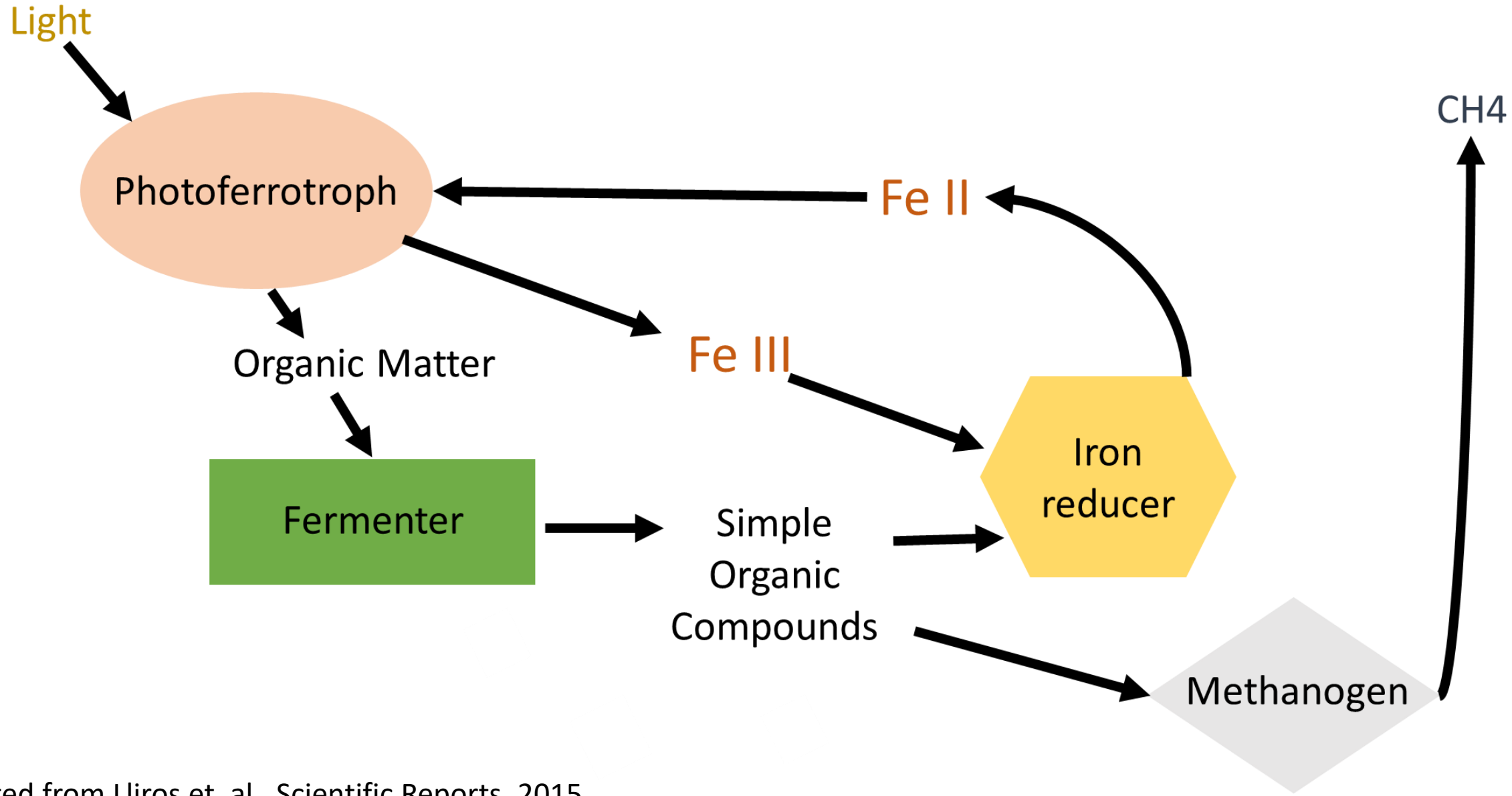


Process rates at Kabuno Bay



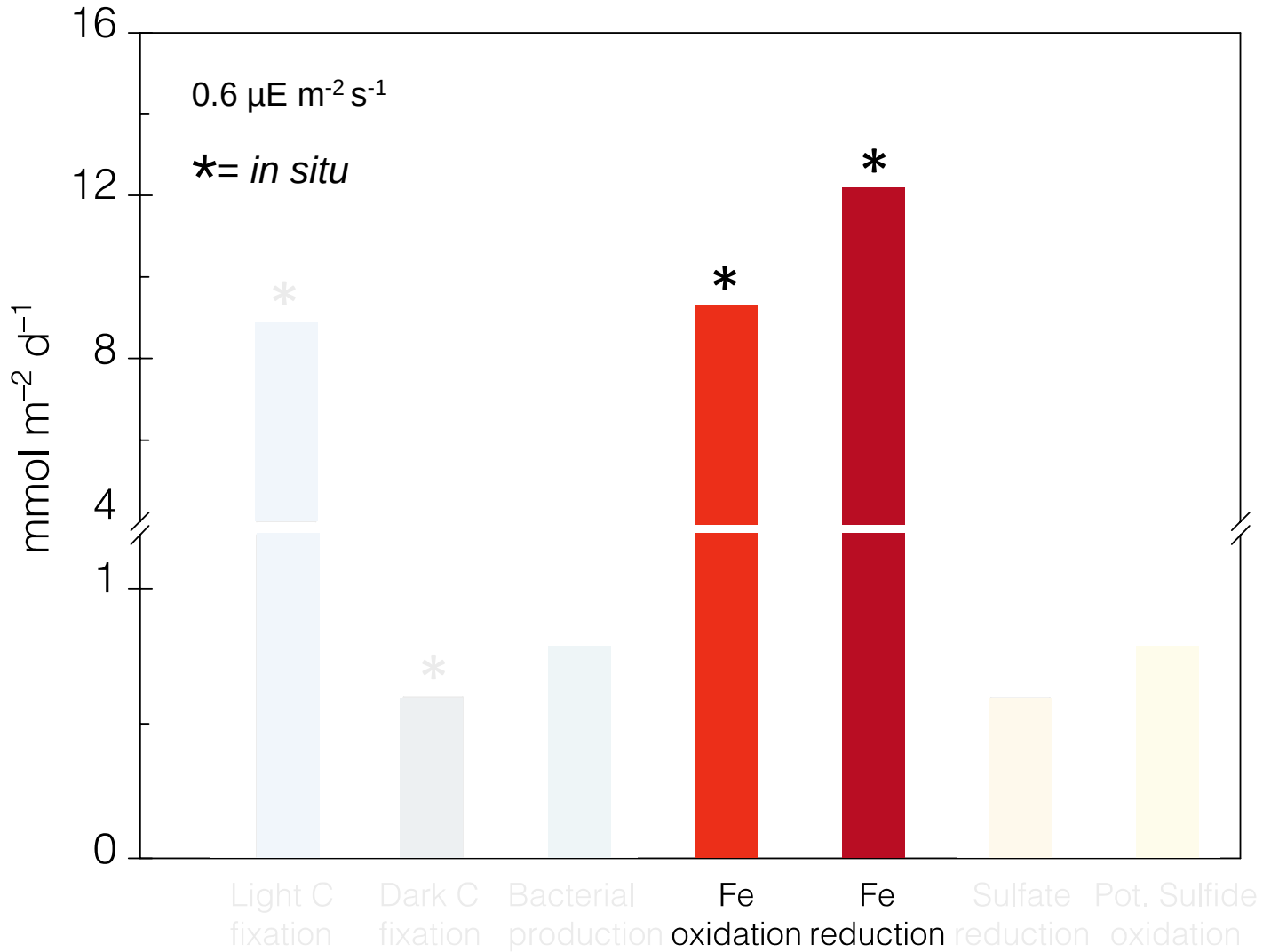
Lliros et. al., Scientific Reports, 2015

Iron-Carbon cycle model



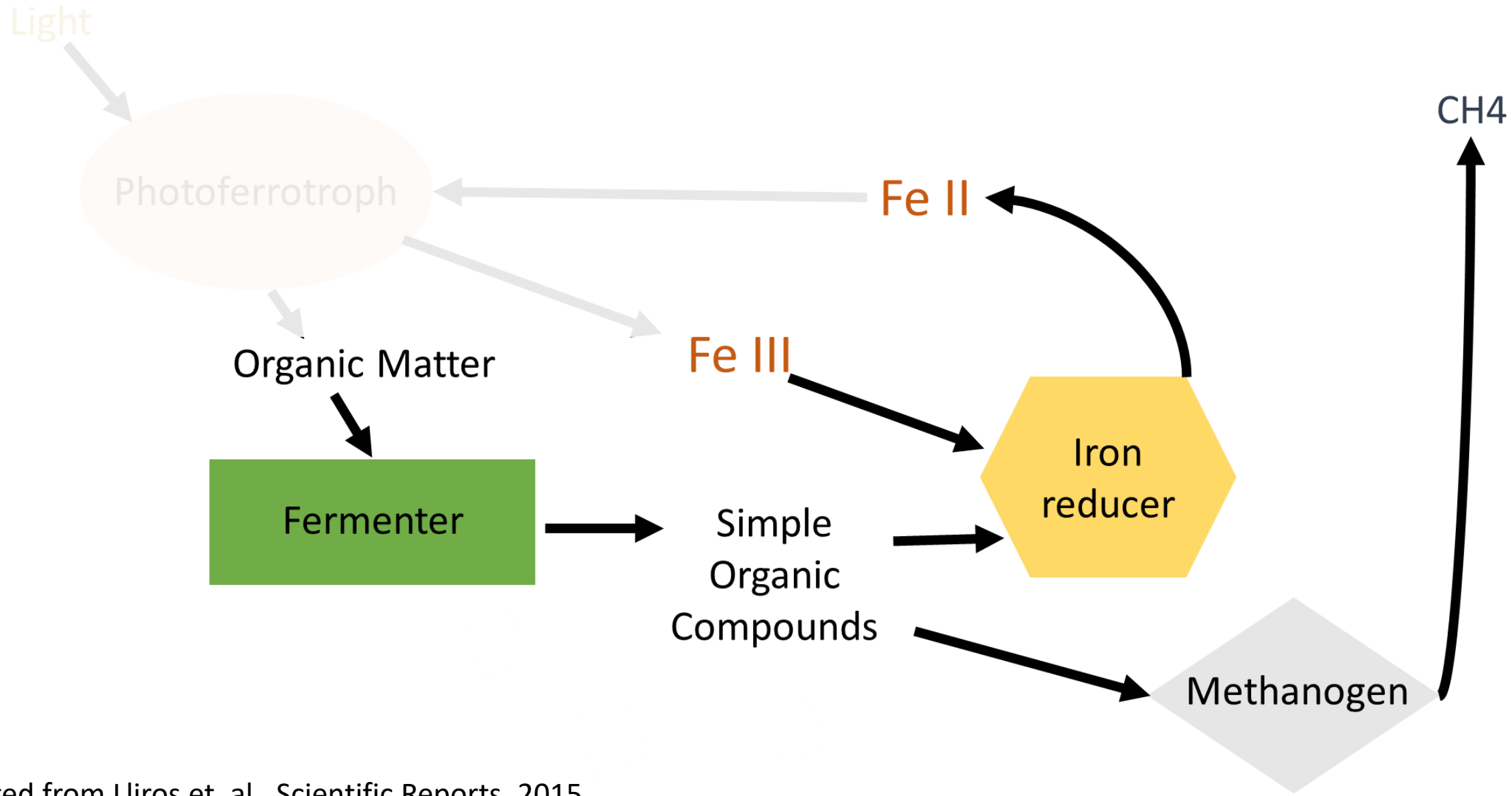
Adapted from Lliros et. al., Scientific Reports, 2015

Process Rates at Kabuno Bay



Lliros et. al., Scientific Reports, 2015

Iron-Carbon Cycle Model



Adapted from Lliros et. al., Scientific Reports, 2015

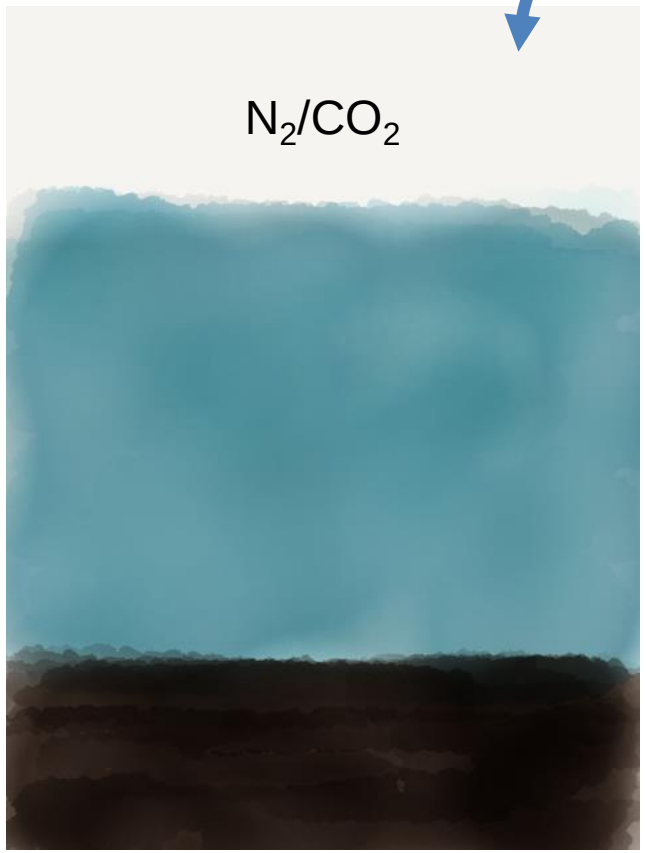
Test conditions

Methanogen conducive

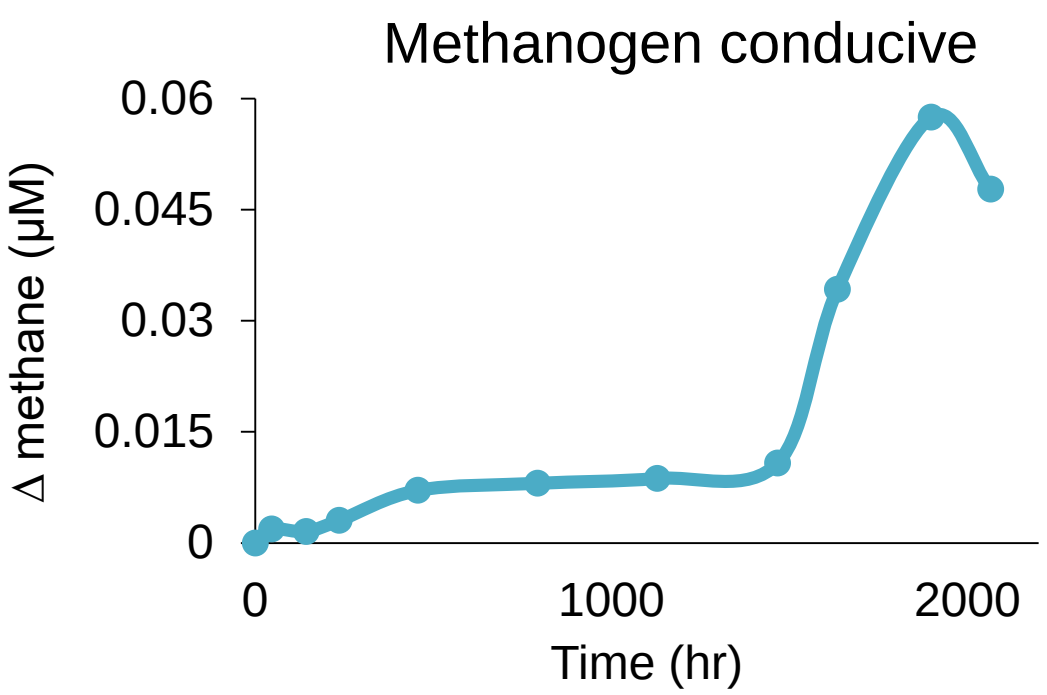
Oxidant:
C.pheaoferrooxidans

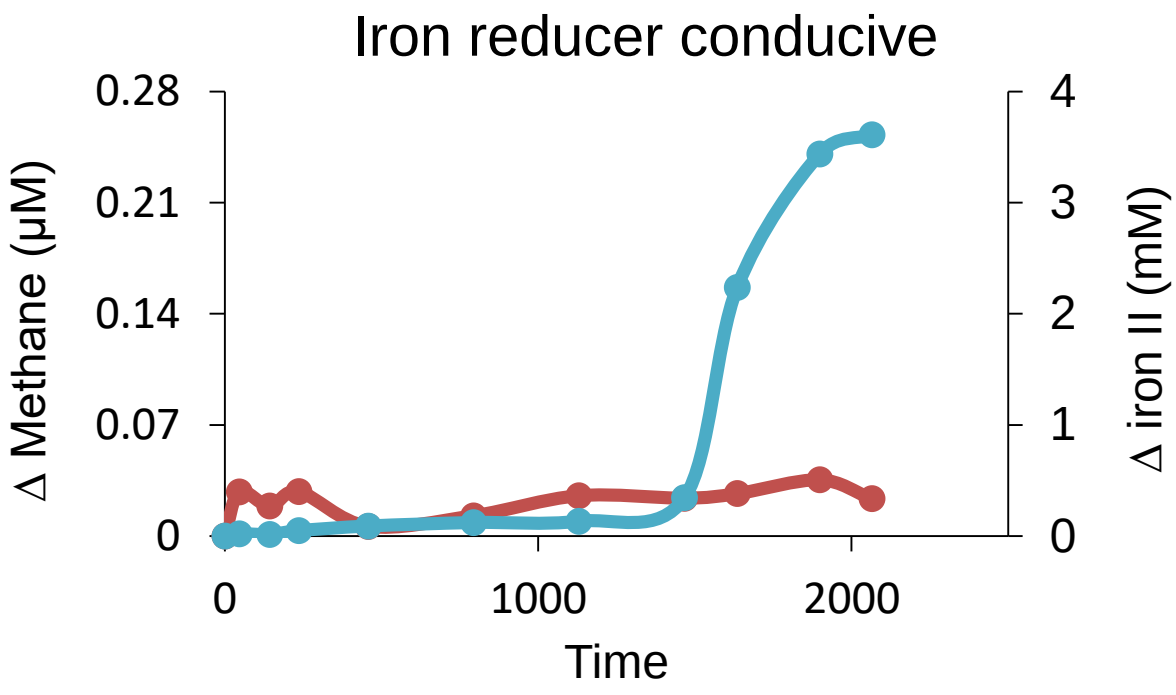
Iron reducer conducive

Reductant:
Iron III



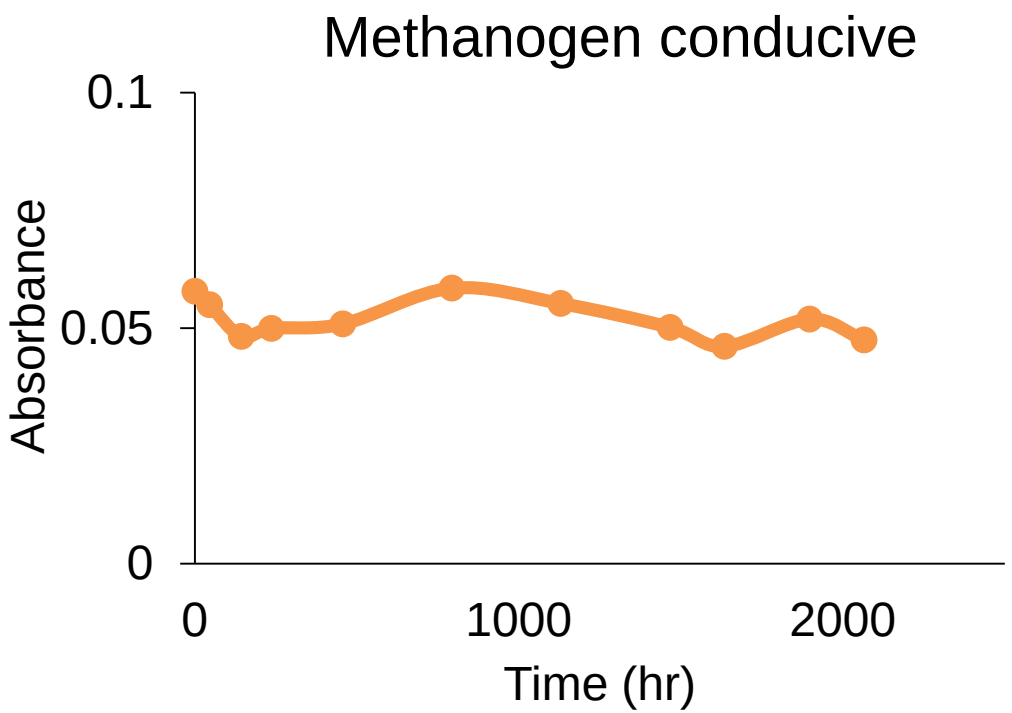
Results

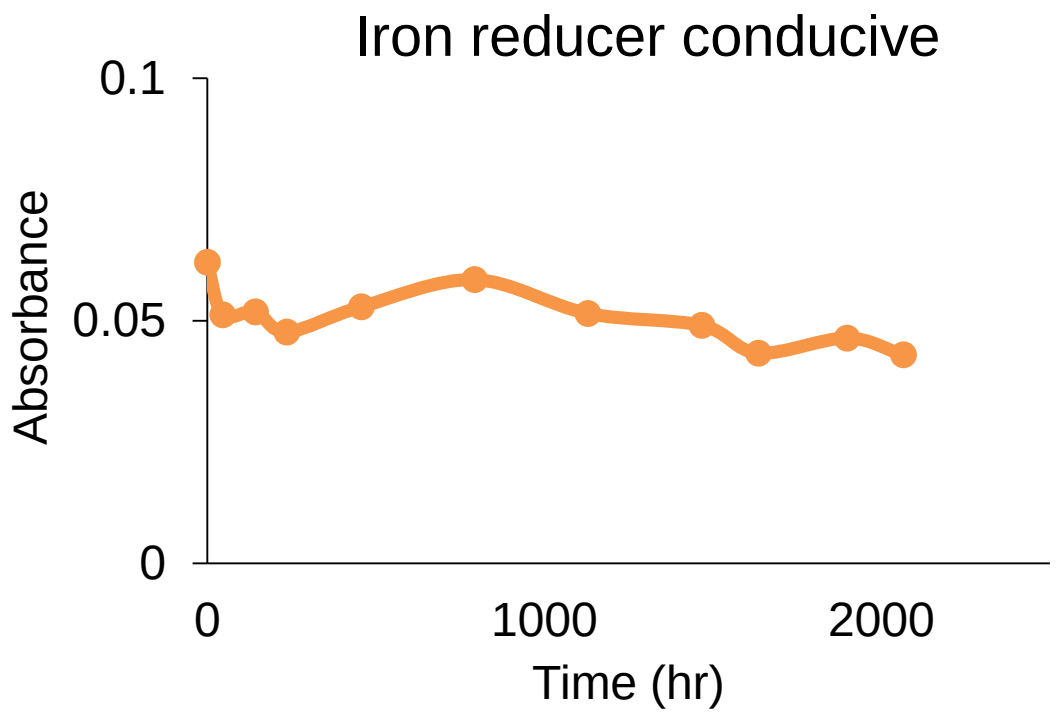




Methane Iron

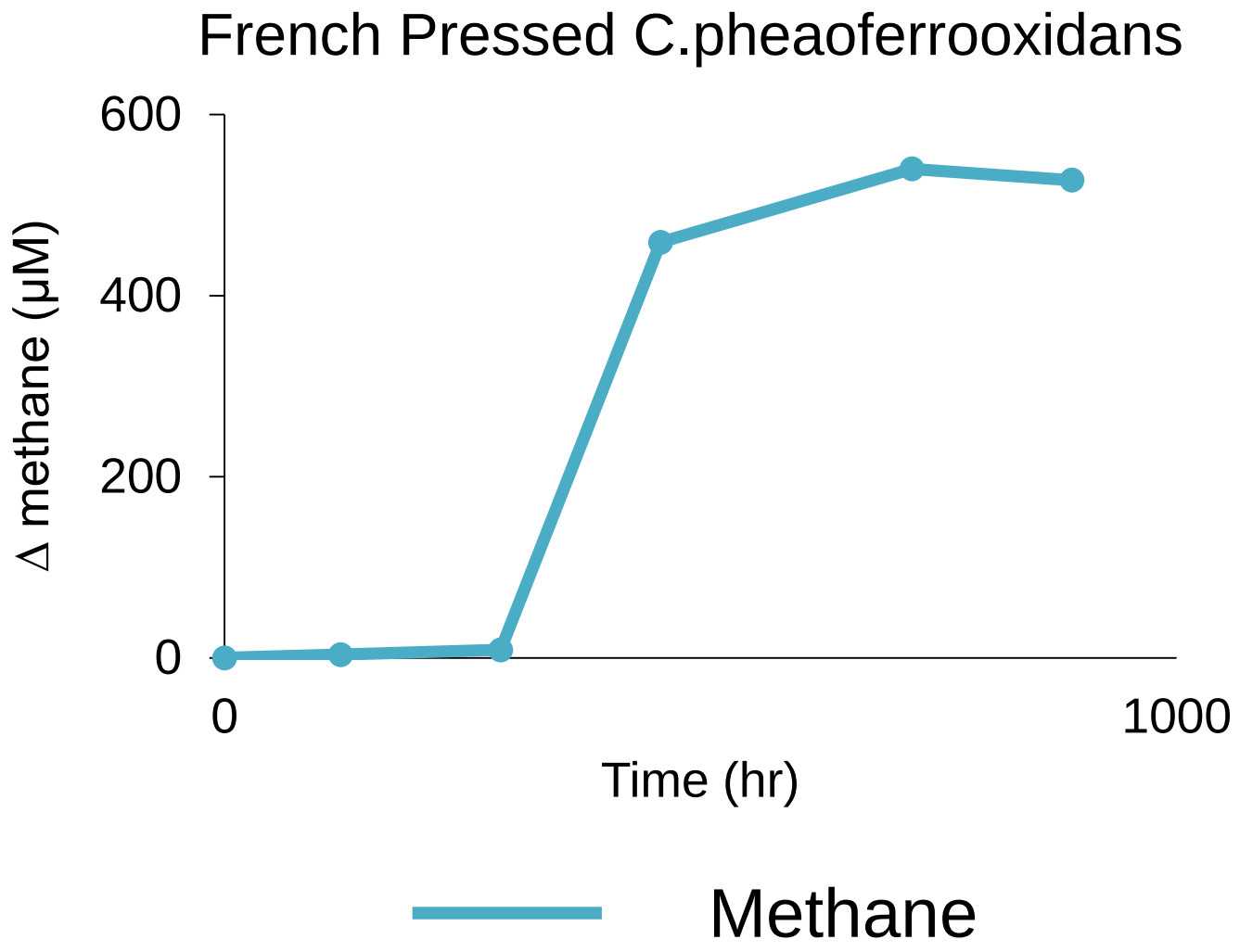
Results





Pigments

Results


French Pressed C.pheaoferrooxidans
600
400
200
0
Δ methane (μM)
0
1000
Time (hr)
Methane

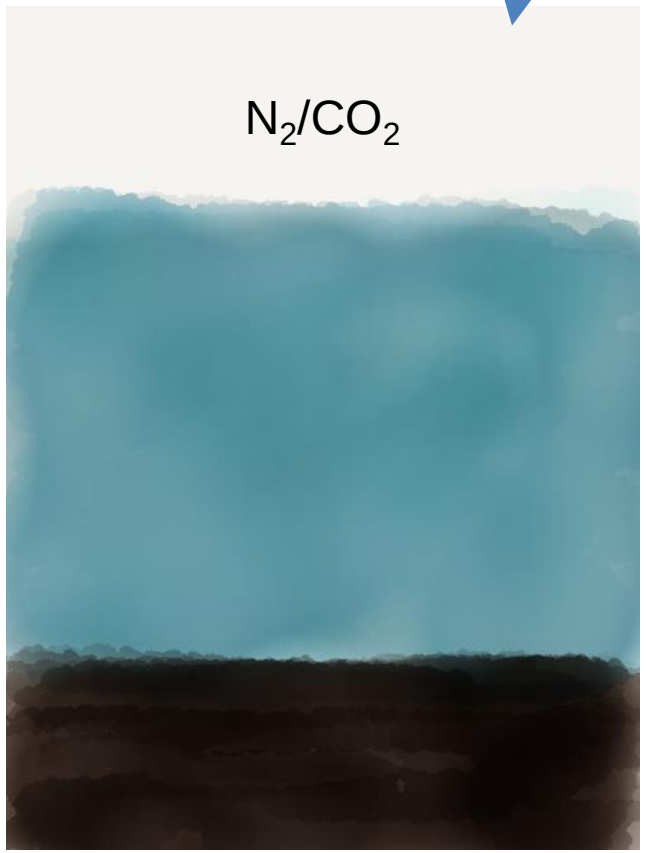
Test conditions

Methanogen conducive

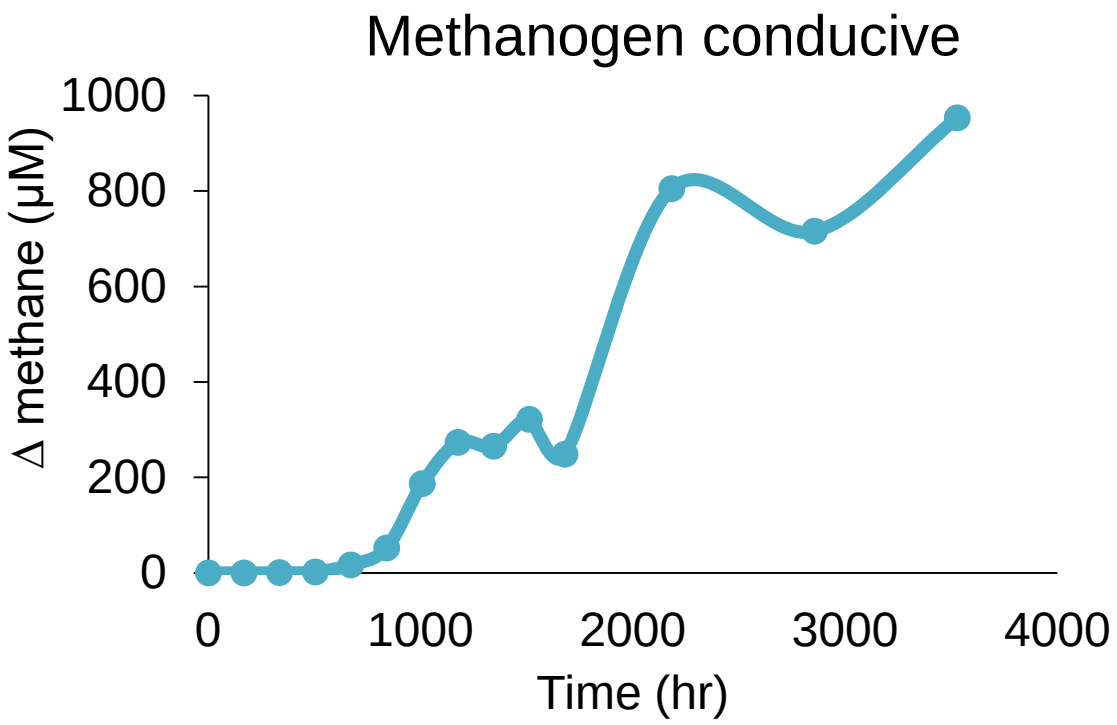
Oxidant:
Yeast extract
+ acetate

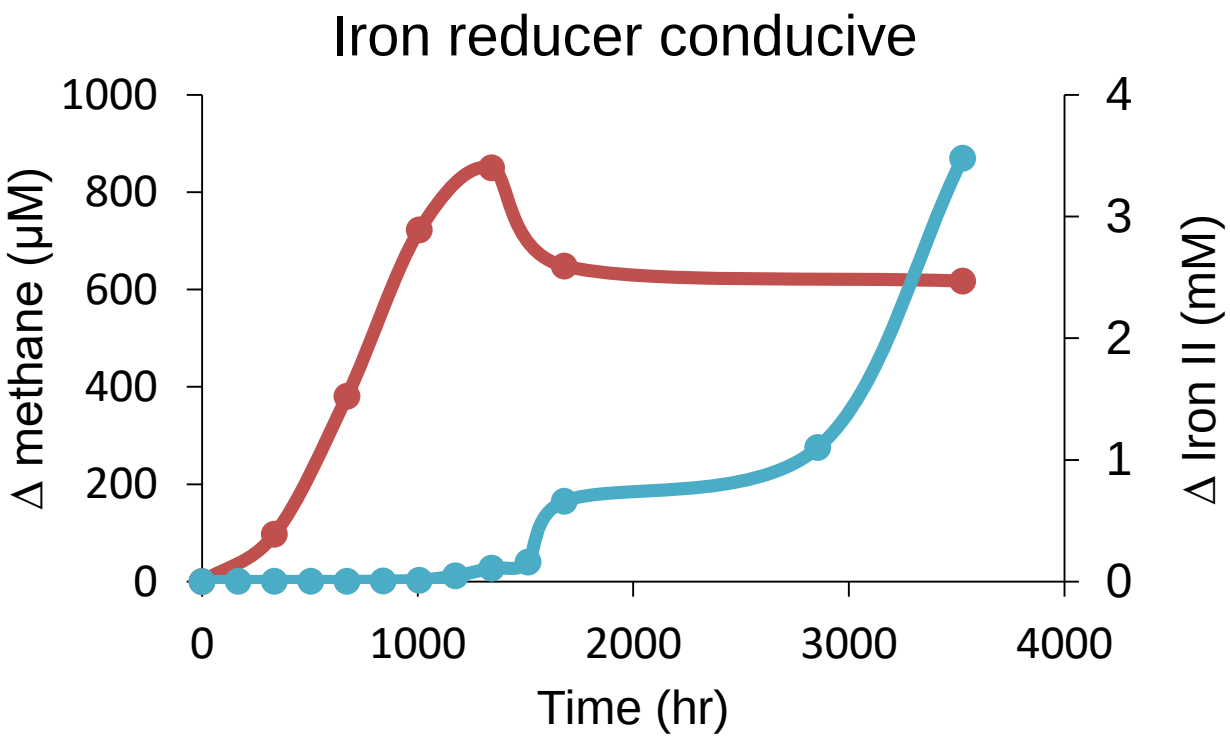
Iron reducer conducive

Reductant:
Iron III



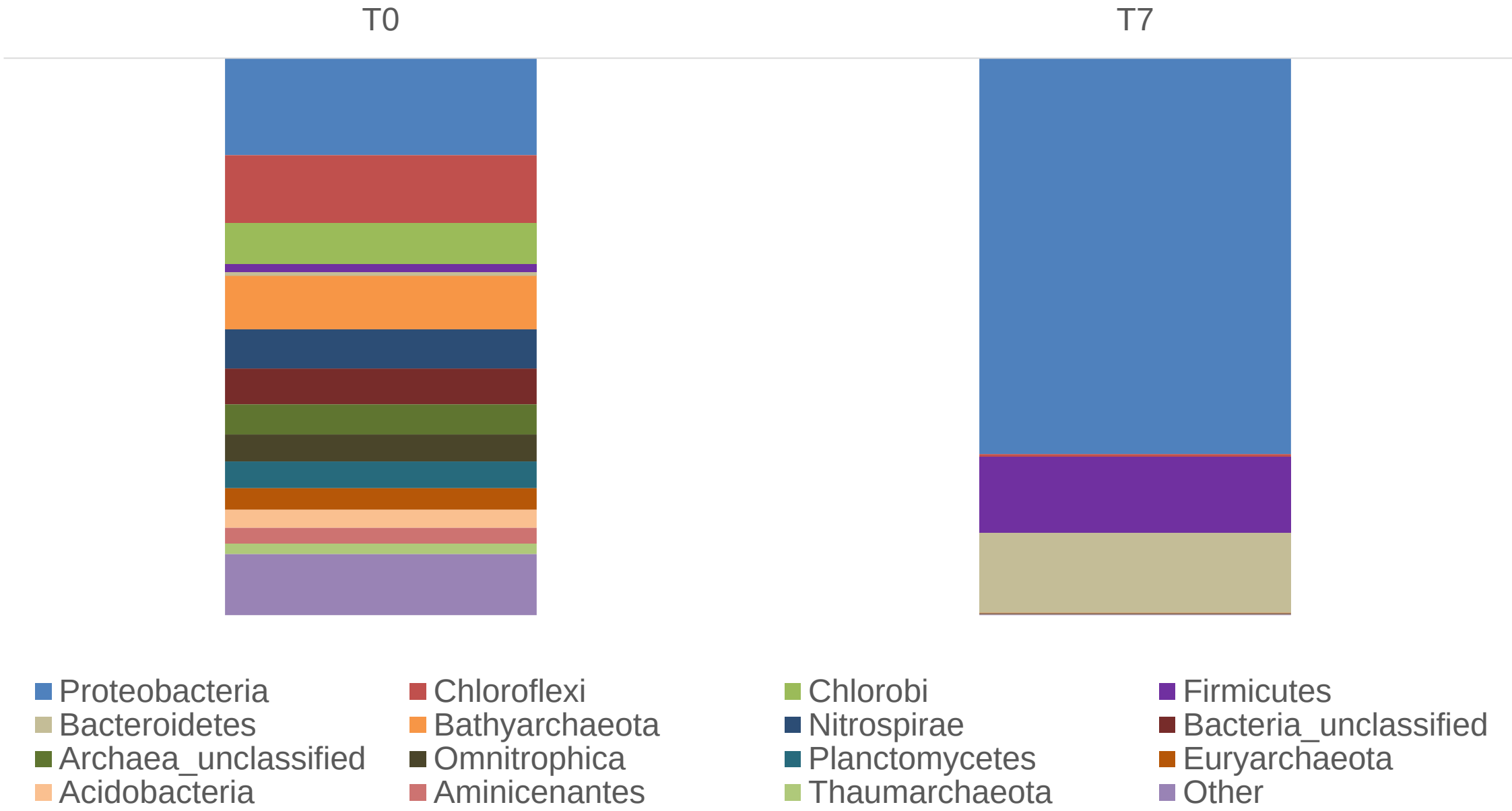
Results





Methane Iron

DNA


T0
T7
Proteobacteria
Chloroflexi
Chlorobi
Firmicutes
Bacteroidetes
Bathyarchaeota
Nitrospirae
Bacteria_unclassified
Archaea_unclassified
Omnitrophica
Planctomycetes
Euryarchaeota
Acidobacteria
Aminicenantes
Thaumarchaeota
Other

Conclusion

- With complex organic matter, methane production detected

- With easily available simple organic matter, iron reduction precedes methane production

- With complex organic matter, fermentation acts as rate limiting step