Microbial Interactions with Crystalline Iron Oxides under Varying Temperature Conditions

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Microorganisms can interact with crystalline iron minerals either as terminal electron acceptors [1,2] or as conduits for electron transfer to syntrophic partners [3]. The environmental parameters and conditions that determine the nature of these interactions are however unknown. We investigated microbial community shifts and interactions with crystalline iron [III] minerals [hematite and magnetite] in ferruginous methanic marine sediment during organic matter [glucose] degradation at varying temperature conditions [4^{o}C, 10^{o}C, 30^{o}C, and 60^{o}C]. The potential for iron reduction in our incubations increased with a decrease in temperature between 60^{o}C and 4^{o}C. Furthermore, crystalline iron minerals were reduced at 4^{o}C hence, serving as terminal electron acceptors. Methanogenesis occurred after iron reduction reached a plateau at 30^{o}C and 10^{o}C with up to two fold enhancement in methanogenesis rates in the mineral amended incubations, thus acting as electron conduits. At 30°C, mineral-mediated transfer of electrons was suspected to have occurred between fermenting bacteria belonging to *Halobacteroidaceae* and methanogens belonging to *Methanosarcinaceae*. At 10°C, electron transfer likely occurred between *Acidaminobacteraceae*, *Bacillaceae* and *Methanosarcinaceae*. At 4^{o}C, novel psychrophilic crystalline iron reducers from the bacteria groups, *Sulfurospirillum*, *Psychrilyobacter* and *Desulfuromonadaceae* were enriched. We demonstrate how crystalline iron [III] minerals may play different roles for microbial energy conservation under different environmental conditions.

[1] Lentini *et al*., (2012), *Frontiers in Microbiology*, 3, 404
[2] Hori *et al*., (2015), *Frontiers in Microbiology*, 6, 386
[3] Kato *et al*., (2012), *Environmental Microbiology*, 14, 1646-1654