

## Iron minerals formed by the binary culture of alkaliphilic anaerobic bacteria from the soda lake

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Alkaliphilic iron reduction is remarkable by the process which occurs in the environment where iron is completely immobilised. Iron minerals formation at pH 9.5 in course of growth of the binary culture containing two new alkaliphilic anaerobic bacteria *Anaerobacillus alkalilacustre* and *Geoalkalibacter ferrihydriticus* [1, 2] isolated from Central Asia soda lake with moderate salts content was studied in laboratory experiments. Mössbauer spectroscopy and scanning microscopy were used for the investigation of solid phase; Fe (II), fermentation products and cell counts were recorded during the bacterial growth.

*A. alkalilacustre* ferments carbohydrates only and does not reduces amorphous Fe (III) hydroxide (AFH) by indirect action. Fermentation products formed during its growth on mannitol were lactate, formate and acetate. *G. ferrihydriticus* does not ferment carbohydrates, but utilizes acetate and lactate reducing AFH to siderite or magnetite [3]. Mannitol (1 g/l) and AFH were added as electron donor and acceptor during the experiments (initial content of Fe (III) in AFH was 10 or 100 mMol) with combined cultures of two anaerobic alkaliphiles. Reduction depends from the initial content of acceptor. Complete reduction of AFH by the binary culture with mannitol as electron donor led to formation of siderite oolites when initial content of Fe (III) was 10 mMol. When initial content of Fe (III) was 100 mMol up to 50 mM of Fe (III) was reduced into the mixture of siderite and non-stoichiometric magnetite. In the control with pure culture of *G. ferrihydriticus* on acetate as an electron donor complete reduction to siderite was observed at 10 mMol of Fe (III) but only 24 mMol of Fe (II) was formed at 100 mMol of Fe (III).

Due to synergistic action binary culture was far more effective in Fe (III) reduction even with substrates not used by iron reducer.

[1] Zavarzina *et al.* (2009) *Mikrobiologiya*, **78**, 723–731.

[2] Zavarzina *et al.* (2006) *Mikrobiologiya* **75**, 775–785.

[3] Chistyakova *et al.* (2008) *Hyperfine Interact.* **182**, 55–63.

## Constraints on transient $p\text{CO}_2$ variations based on oceanic calcium, CCD, and terrestrial weathering

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In an earlier paper, Tyrrell and Zeebe developed a method to reconstruct long-term changes in the deep-sea carbonate ion concentration, which provides constraints on atmospheric  $\text{CO}_2$  (GCA, 2004). The method was based on CCD- and oceanic calcium records and was designed for long-term reconstructions over millions of years. Can a similar method be developed for shorter time-scales to estimate  $p\text{CO}_2$  levels during aberrations such as the PETM? If the contemporaneous  $p\text{CO}_2$ -weathering relationship was perfectly known, then the CCD overshoot during the recovery phase would constrain the mass of carbon input and thus atmospheric  $\text{CO}_2$  levels. However, this requires knowledge of three critical issues: (1) the changes in the ocean's calcium inventory, (2) the amplitude of the CCD overshoot, and (3) the strength of the weathering feedback. We will present new PETM modeling results that adequately constrain changes in oceanic calcium (issue 1). The amplitude of the CCD overshoot can be reconstructed based on sediment core data along appropriate depth transects (issue 2). Finally, variation of weathering parameters will constrain the possible range of atmospheric  $\text{CO}_2$  concentrations that are consistent with observations (issue 3).