



The sulphate-reduction alkalinity pump tested

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Carbonate precipitation has been suggested to be induced by alkalinity increase during sulphate reduction under anoxic conditions. This mechanism may explain the formation of carbonate deposits in shallow marine environments, either within a redox stratified sediment inhabited by phototrophic microbial mats or in shallow water within the photic zone where sulphidic water is upwelling onto the shelf. The alkalinity pump may work as long as the sulphide is not reoxidized to sulphate, a process that would acidify the surrounding.

The alkalinity effect of sulphate reduction was recently tested by Aloisi (2008) for microbial mats using a model approach. He found that sulphate reduction does not significantly increase or even decrease carbonate saturation and is unlikely to have played a significant role through Earth history. The model considers many environmental factors, including the effect of carbonate precipitation itself on the carbonate equilibrium and on the alkalinity. We used a modified version of Aloisi's (2008) model to simulate the saturation states of aragonite, calcite and dolomite without the effects of carbonate precipitation. This is necessary to evaluate the effect of microbial metabolisms exclusively on carbonate saturation, since carbonate precipitation is only the consequence, but not the cause of oversaturation.

First results show that the saturation state is increased in the zone of phototrophic CO₂ uptake. In contrast, the saturation state is strongly decreased in the zone where dissolved oxygen overlaps with dissolved sulphide. Aerobic sulphide oxidation consumes most of the HS⁻ and dissipates most of the alkalinity produced in the sulphate reduction zone below. Hence, our results are consistent with the findings of Aloisi (2008), and they even more clearly show that sulphate reduction does not induce carbonate precipitation nor contributes to carbonate precipitation in combination with phototrophic CO₂ uptake. The alkalinity effect of sulphate reduction is not strong enough at the depth of phototrophic CO₂ uptake to have a sufficient mutual effect with phototrophy. Our results further highlight the necessity to re-think the generally accepted concepts of microbially induced carbonate precipitation in phototrophic microbial mats.

Aloisi, G. (2008) The calcium carbonate saturation state in cyanobacterial mats throughout Earth's history. *Geochim. Cosmochim. Acta* 72, 6037–6060.