



Insights on carbonate diagenesis in methanogenic zones from full-speciation reaction-transport modelling

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Diagenetic carbonates in marine sediments contribute to the global burial of carbonates (Schrag et al., 2013; Sun & Turchyn, 2014). The carbonates often form in zones of enhanced anaerobic microbial activity, where the consumption and release of metabolites leads to supersaturation of the porewater with respect to carbonate minerals.

Some diagenetic carbonates occur in zones of methanogenesis, where methane concentrations can be very high and reach gas hydrate stability. So far, it has not been clarified how carbonate formation is induced in methanogenic zones. The production of methane by both fermentation of acetate and reduction of carbonate by H₂ is stoichiometrically linked to release of excess CO₂ and, therefore, should lower carbonate supersaturation in the porewater.

Nevertheless, porewater extracted from drill-cores across methanogenic zones, as at ODP Site 1230 in the Peru-Chile Trench, shows very high total alkalinity of 150 mmol/l, buffering the acidification imposed by the CO₂. Based on full-speciation reaction-transport modelling (Meister et al., 2022), it is possible to reproduce alkalinity production as a result of the combined effects of dissimilatory release of ammonia and dissolution/alteration of clay minerals under high pCO₂ conditions. Hence, acidification of the fluid is buffered by mineral reactions. In this way, silicate alteration in marine sediments may represent a significant CO₂ buffer that contributes to the formation and burial of diagenetic carbonates.

Schrag, D.P., Higgins, J.A., Macdonald, F.A., Johnston, D.T. (2013) Authigenic carbonate and the history of the global carbon cycle. *Science* 339, 540–3.

Sun, X., Turchyn A.V. (2014) Significant contribution of authigenic carbonate to marine carbon burial. *Nature Geoscience* 7, 201.

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porewater chemistry and diagenetic carbonate formation. *Frontiers in Earth Science* 9, 756591, 1-18. <https://doi.org/10.3389/feart.2021.756591>