

Review of silicate weathering in anoxic marine sediment and its role in authigenic carbonate burial

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Carbon burial as authigenic carbonate constitutes a carbon sink critical in carbon cycling over Earth history. We present a simple model to show that methanogenesis (i.e. organic carbon disproportionation to form methane and CO₂) will lower the pore water pH to values as low as 6, and in so leads to conditions that are undersaturated with respect to carbonate minerals. These conditions are not observed in marine sediments, where carbonate minerals are not only preserved, but are known to precipitate in the form of authigenic mineral phases. Carbonate precipitation below the sulfate-methane transition is only possible when marine silicate weathering (MSiW) reactions convert CO₂ to bicarbonate. We present various examples of pore water data from passive and active margins where either ash or clastic minerals constitute the reactive silicate phase that generates the alkalinity and the cations needed for carbonate precipitation in the methanogenesis zone. We review evidence in support of these MSiW reactions and the use of strontium isotopes as tracers for silicate alteration and the resulting carbonate minerals. We highlight the global extent of these carbon-silica coupled processes, which trap carbon as carbonate minerals at rates similar to carbonate sequestered by alteration of oceanic crust.