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Sulfur-carbon cycling in a temperate tidal system from Pleistocene to modern time: Evidence from sedimentary sulfur and carbon isotopes, and pyrite textures

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Little is known about biogeochemical carbon-sulfur(-metal) cycling in organic matter- and/or iron-limited tidal coastal environments and the formation of corresponding sedimentary geochemical signatures.
In the present study, we analyzed two 20 m-long cores that were recovered from the tidal backbarrier area of Spiekeroog Island, NW Germany. The drill sites were selected within a close distance of 900 m allowing comparison of two depositional settings: A palaeo-channel filled with Holocene sediments is compared to a mainly Pleistocene sedimentary succession. Here we report on new results characterizing the stable isotope composition of pyrite sulfur and organic matter (OM) as well as the textures of sedimentary sulfides. Corresponding results for pore water composition and microbiological studies were already presented in Beck et al. (2011).
The carbon isotope signature of organic matter follows sedimentological changes and is essentially controlled by the sources of organic matter and therefore the paleo-environmental conditions. Additionally, the original signatures may have been superimposed by diagenetic degradation reactions. The stable isotope composition of inorganic sulfur (essentially pyrite) between about -30 and +20 per mil vs. V-CDT reflects changes in the sedimentary conditions like sulfate availability (salinity) and activity of sulfate-reducing bacteria. This is in line with the occurrence of framboidal textures indicating that most of the pyrite was formed close to the sediment-water interface. Irregular framboids, clusters, and euhedral pyrite indicate different zones of iron sulfide formation. The heavy sulfur isotope signatures point to zones in which primary signatures are overprinted diagenetically by in-situ processes. They may have been caused by transport of dissolved sulfur species formed by microbial activity (e.g., AOM).
Results from the drilled cores are compared to and calibrated by seasonal studies on the development of sulfur and carbon cycling and corresponding stable isotope signatures in recent intertidal sandy and muddy surface sediments.

References:
Beck et al. (2011) Biogeosciences, 8, 55
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