

# **Sulfate Reduction and Sulfide Oxidation in the Sediments with Cryptic Sulfur Cycle are controlled by High Aeolian Reactive Iron Fluxes**

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In sediments with high content of reactive iron oxides, nearly all hydrogen sulfide, produced by microbial sulfate reductions (MSR), is reoxidized to sulfide oxidation intermediates (sulfur, thiosulfate, and sulfite) and, eventually, to the terminal oxidation product, sulfate. Such cryptic sulfur cycling was proposed in the sediments of the Gulf of Aqaba, Red Sea, based on the indirect evidence, including  $\delta^{18}\text{O}$  and  $\delta^{34}\text{S}$  composition of sulfur species, presence of sub-micromolar concentrations of hydrogen sulfide, sulfide oxidation intermediates and traces of pyrite [1,2]. In this work, we provide quantitative constraints on the cryptic sulfur cycle in the sediments of the Gulf of Aqaba. We measured MSR by incubation with  $^{35}\text{S}$  radiotracer sulfate [3] and show that MSR is present, but indeed inhibited by the high contents of iron oxides. Sub-millimolar concentrations of hydrogen sulfide and trace amounts of pyrite in the sediments result from a combination of low rates of MSR and high rates of hydrogen sulfide oxidation. Pseudo-first order rate constant of hydrogen sulfide oxidation calculated from the MSR rates and direct measurements provide similar results. Similar geochemical fingerprints of sulfur cycling were also observed in other marine systems affected by dry aeolian deposition [4]. We suggest that the cryptic sulfur cycle may be ubiquitous in marine sediments that are situated in the desert environments.

[1] Blonder, B., et al. (2017) *Front.Microbiol.* 8:1131.

[2] Boyko, V., Blonder, B., Kamyshny Jr., A. (2019) *Mar. Chem.* 216:103691.

[3] Fossing, H., Jørgensen, B.B. (1989) *Biogeochemistry* 8, 205-222.

[4] Boyko, V., Pätzold, J., Kamyshny Jr., A. (2021) *J. Geol. Soc. London* jgs2021-027.