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Living with and even benefiting from polysulfide species : an achievement of hyperthermophilic archaea

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Hydrothermal vents are a site of redox exchange between reduced deep hydrothermal fluids and oxidized ocean water. Thermococcales hyperthermophilic archaea are now well known for their ability to promote the formation of FeS_2 pyrite[1] in hydrothermal systems and thus to participate in the oxidation of S^{2-} sulfide ions which are the major sulfur species in the hydrothermal fluid. In the present study, we suggest the presence in the strictly anoxic culture medium of *Thermococcus kodakarensis* of inorganic tri- and tetra-sulfide species. The possible mechanisms of formation of such polysulfide species are understood using thermodynamic and kinetic geochemical modelling tools. Using experimental observations of minerals at the nanoscale in cultures of *T. kodakarensis* together with this thermodynamic and kinetic modeling, we show that these microorganisms could contribute to global-scale redox regulation. Moreover, we suggest that H_2 production by dark fermentation in these archaea is regulated by the FeS/FeS_2 mineral balance. Interestingly, recently described sulfur and organics/sulfur biomorphs[2] might play a non-negligible role in such redox regulation processes in addition to active living matter. Finally, these observations and models suggest that the bio-mineralogy of hydrothermal vents in the Archean eon when hydrothermal fluids discharged into a strictly anoxic ocean may have been very different from the present

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