Cyanobacteria Sulphur Physiology under Paleoproterozoic Conditions

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Photosynthetic Cyanobacteria are ancient organisms which appeared on Earth around 2.5 Gya, oxygenating the planet [1, 2]. Since their physiology produces O_2 implies they were/become able to survive in the presence of this high potential and highly reactive molecule. In addition to potential toxicity derived from O_2 reactions, O_2 was also an enabler in the ocean environment allowing the realise of a vast amounts of sulfur, molybdenum, copper, and other elements in the water column [3]. We sought to test the following hypotheses: a) that redox regulation of sulfur assimilation at the ATP Sulphurylase (ATPS) step may result in differences in biomass sulfur isotope composition [4] and b) that marine and freshwater strains may alter their metabolism in fundamentally different ways, based on the ATPS redox switch [5].

We have initiated tests of these hypotheses by using two model experimental organisms: *Synechocystis* sp. PCC6803 and *Synechococcus* sp. WH7803. These organisms reacted differently to the paleo-reconstructed environment: decreased oxygen concentration, coupled with an increase in CO_2 and variations in SO_4^{2-}, Fe^{3+}, and NO_3^- in the growth media affected the growth rate and the photosynthetic pigment production. Furthermore, preliminary results reveal a difference in the ATPS activity between these conditions, indicating variation in the sulfur assimilation pathway. A comparison of sulphur stable isotopes levels (between SO_4^{2-} and biomass pool) and of proteomic sets, coupled with the analyses of the growth rate, allow understanding how the two biological processes differ between these two different strains which have been exposed to chemical conditions consistent with two different times.

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