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On the Photosynthetic Potential in the Very Early Archean Oceans

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Abstract In this work we apply a mathematical model of photosynthesis to quantify the potential for photosynthetic life in the very Early Archean oceans. We assume the presence of oceanic blockers of ultraviolet radiation, specifically ferrous ions. For this scenario, our results suggest a potential for photosynthetic life greater than or similar to that in later eras/eons, such as the Late Archean and the current Phanerozoic eon.

Keywords Early Archean life · Ultraviolet radiation · Ozone · Photosynthesis

Introduction

Seemingly, the origin of photosynthetic life took place approximately 3.5 Ga ago, during the Archean Eon. There are three main lines of evidence for the antiquity of photosynthesis: chemical markers, microfossils of ancient organisms and stromatolite fossils (Olson and Blankenship 2004). Among the chemical markers the ratio of $^{13}C/^{12}C$ in sedimentary organic carbon (kerogen) indicates a continuous record of biological CO_2 fixation that goes back 3.5–3.8 Ga (Schidlowski et al. 1983; Schidlowski 1988). However, the most persuasive evidence is the existence of the Early Archean stromatolites: layered structures consisting of alternate layers of mat-forming organisms and sediment, extant stromatolites almost always containing filamentous photosynthetic bacteria and/or cyanobacteria. There is also a continuous fossil record of stromatolites from structures dated at 3.1 and 3.5 Ga (Walter 1983), suggesting that phototrophs had already emerged 3500 million years ago (Awramik 1992).

It is stated that the very first organisms capable of doing photosynthesis were anoxygenic, but then were overwhelmed by more efficient photoautotrophs: cyanobacteria. At this time,

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