PhD thesis project (Oct. 2019 start)

Constraining the early evolution of Earth's photosynthetic pathways: An isotopic approach

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Summary

The origin of oxygenic photosynthesis is one of the most dramatic evolutionary events that the Earth has ever experienced. At some point in Earth's first two billion years (Ga), primitive phototrophs acquired the ability to harness sunlight, oxidize water, and release O_2, all the while converting CO_2 to organic carbon with unprecedented efficiency. During the Great Oxidation Event (GOE) around 2.5 to 2.3 Ga ago, O_2 began accumulating permenantly in the atmosphere, a process that forever changed the chemistry of Earth's surface and marine environments. Earth's modern biosphere owes its existence to this planet-defining metabolism, and understanding its origin is a paramount challenge in Earth system science.

It is widely held that anoxygenic photosynthesis, based on the oxidation of reduced sulfur or iron, drove Earth's earliest photosynthetic ecosystems until a Paleo- to Mesoarchean origin and rapid expansion of oxygenic photosynthesis took over Earth's surface productivity. However, exactly when oxygenic photosynthesis evolved, and whether or not anoxygenic phototrophs continued to make important contributions to primary production afterwards, remains largely unresolved. This project will focus on novel chemical and isotopic signals (e.g., Ce anomalies, Fe isotopes, rare earth element isotopes) preserved in chemical sedimentary rocks and other fine-grained marine sediments deposited between 3.2 and 2.7 Ga to better understand the evolution of photosynthetic pathways on the early Earth. Candidates should have clean lab experience as well as prior experience in trace element analyses as well as chromatographic separation of transition metals and/or REE and stable isotope analyses by multi-collector ICP-MS or TIMS. Strong english skills are required. This PhD project is offered in the context of the ERC Starting Grant "EARTHBLOOM".