Proterozoic analog ecosystem and organic biomarkers in a Florida sinkhole

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Competition between oxygenic and anoxygenic phototrophs has been proposed as a mechanism that delayed the oxygenation of the Earth's oceans and atmosphere in the Proterozoic [1]. Factors affecting competition among modern phototrophs are not well understood, especially under low oxygen conditions thought to have been prevalent in Precambrian oceans. Little Salt Spring (Sarasota County, FL, USA) is a brackish, sulfidic sinkhole hosting a mixed community of oxygenic and anoxygenic phototrophs. Groundwater vents discharge into the bottom water at 73 m depth, and thick, purple microbial mats cover sediment surfaces in the sunlit upper basin. 16S rRNA clones from the mat were affiliated with *Cyanobacteria* and *Chlorobi*, with smaller numbers of *Deltaproteobacteria* in sulfate-reducing clades. Six bacteriochlorophyll e homologues and isorenieratene reflect contributions from *Chlorobi,* and abundant chlorophyll a and pheophytin a likely derive from *Cyanobacteria*. Hopanoid content of the mat is high (29% of total membrane lipids). The relative abundances of polar hopanoids in the mat are preserved in organic-rich surface sediments accumulating in the deep portion of the sink. Remarkably, more than half of the hopanoids in the mat and surface sediments have 2-methyl structures, which are preserved in the geologic record as 2-methyl hopanes and have been interpreted as biomarkers for *Cyanobacteria*. PCR amplification of the hopanol 2-methylase (*hpnP*) from mat DNA retrieved a sequence affiliated with other cyanobacterial HpnP homologs. Ongoing work at the site is aimed at: (1) a quantitative model of anoxygenic and oxygenic contributions to net primary productivity and biomarker production; (2) understanding the ecological factors that promote the co-existence of oxygenic and anoxygenic phototrophs in the mat; and (3) describing the timescale and chemical changes associated with diagenesis of organic biomarkers.

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Combined SIMS U-Pb ages and Ti-in-zircon geothermometry fingerprints long deep crustal residence in the Archaean

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Combined SIMS U-Pb ages and Ti-in-zircon geothermometer temperatures for a population of zircons from Archaean gneisses indicate long deep crustal residence at >780°C for >350Ma. This technique of having both an age and minimum temperature for each analytical spot is a new and direct way of showing that heat flux from the mantle to the base of the crust was higher in the Archaean than the present day.

The rocks are TTG gneisses from the polymetamorphic Archaean-Palaeoproterozoic Lewisian Gneiss Complex of NW Scotland. The analysed zircon population comprises a small number of primary magmatic cores and a range of metamorphic domains; CL imaging showed that the metamorphic domains were either rims or whole crystals of uniform CL. The metamorphic domains comprised a mix of anatectic growth and recrystallisation textures. U-Pb data produced a spread of ages from 2.5-2.8Ga with some ages older than this. Tight discordance limits (+5/-2%) were applied so only the best, most concordant age data were used. Ti analyses were filtered to exclude those from plastically-deformed (EBSD data) and contaminated (Ba >1ppm) zircons.

We interpret the data as TTG protolith formation around 2.8-3.0Ga followed by granulite-facies metamorphism at 2.8Ga. The studied part of the Lewisian Complex remained at >780°C up until 2.5Ga when it was cooled, possibly by uplift and erosion. This 300 My period of elevated temperature contrasts with Phanerozoic crustal behaviour, in which such high grade rocks are cooled over much shorter timescales.