

Records of Life in the Dark: Potential Lithoautotrophic Biosignatures from the Pliocene Gray Fossil Site, Tennessee, USA

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Preliminary geochemical investigation of Pliocene (4.5-4.7 Ma) sediment cores recovered from the Pliocene Gray Fossil Site (East Tennessee, USA) led to identification of a series of 3,7-dimethylalkanes among their aliphatic hydrocarbon constituents (Fig. 1). 3,7-dimethylalkanes have been previously reported in insect pheromones [1, 2], algae [3, 4], and lithoautotrophic archaea and bacteria [4, 5]. The carbon number distribution of the 3,7-dimethylalkanes, coupled with the absence of series of other dimethylalkanes, suggests affinities with prior reports of these compounds in lithoautotrophs and in Precambrian sediments [ref]. Unlike Precambrian settings, the sediment sequence from the Gray Fossil Site is dominantly comprised of limestone and dolostone deposited as a cave collapse into a sinkhole lake. Hence, this setting represents an environment wherein the microbial communities likely included lithoautotrophs, utilizing carbonate rocks as their carbon source. This presentation focuses on the possibility that 3,7-dimethylalkanes can serve as a proxy for lithoautotrophs through evaluation of their molecular distributions and isotopic compositions. It will consider possible biosynthetic pathways for producing 3,7-dimethylalkanes and their likely precursors as well as discuss evidence that suggests their origin from lithoautotrophs while precluding other potential sources. Confirmation that sedimentary 3,7-dimethylalkanes represent biosignatures for lithoautotrophs would facilitate assessment of the contributions of these microbes through geological time, especially in cave and karst systems and at depths in Earth's crust. A biomarker proxy for lithoautotrophy is also relevant to the search for life on Mars.

References

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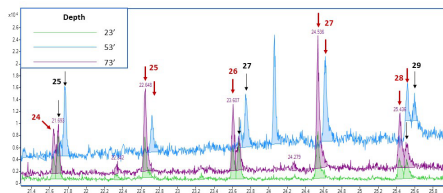


Figure 1: Mass chromatogram of m/z 127 illustrating distributions of 3,7-dimethylalkanes (black arrows) and n -alkanes (red arrows) within the aliphatic hydrocarbon constituents of three sediment samples from different depths of the Gray Fossil Site.