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Exploring the effect of simple carbon sources on analogs of early alkaline hydrothermal vents for insights into the emergence of life

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Seafloor hydrothermal systems, and in particular early alkaline hydrothermal vents (AHVs), could have been the environment which allowed the emergence of life on Earth [1]. At the origin of life, before enzymes existed, proto-bioenergetic processes must have been initiated by an abiotic system. Minerals are currently the most likely candidates [2]. Their catalytic properties could have favored the production of organic molecules which then served as life's building blocks, and it has been proposed that minerals exposed to out-of-equilibrium conditions may have been able to initiate a primitive form of chemiosmosis, a ubiquitous energy-acquisition process in living organisms [3]. More specifically, iron oxides and oxyhydroxides in early AHVs could have played this role, as supported by the ability of their metallic components to transfer electrons (possibly coupled to proton transfers), and by the structural and functional similarity of some metallic clusters with the active sites of some metalloproteins involved in bioenergetic chains [4,5].

Using an experimental system composed of two solutions which interact at an interface [6], we form analogs of early AHVs and we test the effect of the introduction of prebiotic carbon sources naturally present in AHV environments (CH_4 and CO_2). We focus on the induced organic syntheses using GC-MS, and on the modifications of the mineral phases using XRD, spectroscopy (FTIR-ATR and Raman), and electron microscopy.

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