

Layered double oxyhydroxides, the key minerals to understand bioenergetics mechanisms at the origin of life?

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The emergence of life has been extensively studied, but mainly by looking for organic molecules capable of spontaneously organizing into living entities. From a thermodynamic perspective, such a hypothesis is an absurdity unless life is redefined as a subsystem of a larger one from which free energy flows into the smaller system to drive the entropy decrease associated with being alive.

This free energy converting process in life is what biology calls “bioenergetics”. Bioenergetics thus arguably is the sine-qua-non allowing life to emerge. The set of basic principles underlying bioenergetics has been elaborated from comparative studies of the diversity of microbial bioenergetic systems. This set of principles suggests the existence of pre-biotic, inorganics-based primitive versions of the modern biological free energy converting processes. Resemblances to biological bioenergetic systems furthermore suggest layered, transition-metal-bearing oxyhydroxide nanominerals (abundant on the early Earth), a subset of the anionic clays and related to modern advanced materials, as plausible inorganic precursors to certain bioenergetic processes. Alkaline hydrothermal vents could be a potential environment of early life and are likely to have displayed energy dynamics characteristics analogous to biological bioenergetic systems at the dawn of life.

Our project focuses on experimentally explore the capacities of these layered double oxyhydroxydes minerals to perform the processes crucial to biological free energy conversion in Alkaline hydrothermal vents.

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