

Life as a guide to its own origin

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Abstract:

All life on Earth is powered by electrochemical differences across membranes, most fundamentally the protonmotive force. This universal conservation suggests that membrane bioenergetics arose very early in evolution. I will argue that life began in alkaline hydrothermal systems entailing labyrinths of cell-like pores where CO₂ fixation was driven by geologically sustained proton gradients across thin semiconducting barriers containing catalytic FeS minerals. Experimental work from my own lab as well as ISIS suggests that this far-from-equilibrium setting drove a spontaneous protometabolism with a topology equivalent to the universal core of metabolism. Patterns in the genetic code show that genetic information emerged from direct interactions between amino acids and cognate nucleotides. I will present experimental and theoretical modelling work that together elucidate the emergence of biological information in autotrophic protocells.