Replicating Conditions for the Origin of Life in a Lab

Abstract:

How did life originate on Earth? This has always been a challenging topic generating continuous interest among different fields, such as chemistry, biology, physics, and engineering. The "primordial soup", which has been the most commonly accepted theory, fails to explain how molecules present at low concentrations in the prebiotic oceans could create the building blocks of life, such as proteins and DNA. Since the 1977 Galapagos Hydrothermal Expedition showed the first hydrothermal vents in the deep ocean floor and their ability to provide a favorable environment for life, hydrothermal systems have emerged as an alternative to the "soup" theory and are currently at the center of research intended to explain the origin of life. My research is focused on replicating the conditions for the origin of life in a laboratory scale, trying to understand how hydrothermal vents could produce the high concentrations of relevant molecules necessary to form life's building blocks. Similar to the phenomenon observed in a lava lamp, liquid inside the pores of mineral formations near hydrothermal vents exhibits convective flow, which is generated by thermal gradients established between the cold deep sea water and hot magma from the Earth's crust. We study this by constructing pore-like chambers inside which convective flow can be established in a controlled way. Using this approach, I studied different possible flow trajectories that could occur inside such pores, ranging from well-organized patterns to highly disorganized, or chaotic, flow. The results showed how chaotic flow, in particular, can quickly accumulate molecules in certain regions of the pore-like chambers, providing the necessary high concentrations for the synthesis of life's building blocks. Therefore, my research provides evidence in favor of hydrothermal vents as enablers of the first forms of life in Earth's primitive oceans.