HYDROTHERMAL CONDITIONS DRIVE POLYMERIZATION: OPARIN'S PRESCIENT IDEA.

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A fundamental problem in origins of life research is the process by which the first nucleic acids were synthesized and incorporated into living systems on the primitive Earth. To better understand how this could occur, we are investigating volcanic hydrothermal conditions as a way to drive polymerization. Our approach was foreseen by Oparin who often referred to volcanism and polymers as a way to promote chemical reactions related to the origin of life. During field studies in volcanic hydrothermal regions of Kamchatka, Iceland and Hawaii, it became clear that Oparin's intuition could be extended to synthesis of nucleic acids from their monomers. We have established a laboratory simulation of hydration-dehydration cycles that would occur in hydrothermal fields associated with volcanism on the early Earth. The simulation included the presence of compounds that concentrated and organized the mononucleotides either in eutectic phases or in multilamellar liquid crystals assembled from amphiphilic coimpounds. We confirmed that the chemical potential made available by cycles of hydration and dehydration is sufficient to drive synthesis of ester bonds so that oligomers resembling RNA are produced. Furthermore, when mononucleotides were present that can form complementary base pairs, some of the products have properties suggesting that secondary structures are present, including duplex strands stabilized by hydrogen bonds.

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