COMBINATORIAL SELECTION IN THE PREBIOTIC ENVIRONMENT. D. W. Deamer[1] and B. F. Damer[1], [1]Department of Biomolecular Engineering, University of California, Santa Cruz CA 95064 email: deamer@soe.ucsc.edu

Introduction: We are exploring processes by which mononucleotides can undergo polymerization and encapsulation in simulations of hydrothermal fields associated with volcanic land masses. We observed that RNA-like polymers are synthesized by condensation reactions when mixtures of amphiphilic lipids and mononucleotides are exposed to cycles of dehydration and rehydration.

The lipids concentrate and organize the monomers within multilamellar liquid-crystalline matrices that self-assemble in the anhydrous state. The chemical potential driving the polymerization reaction is supplied under these conditions because water becomes a leaving group and elevated temperature ranges provide activation energy [1]. Significantly, upon rehydration the polymeric products are encapsulated in protocells, defined as microscopic compartments bounded by lipid membranes (Figure 1).

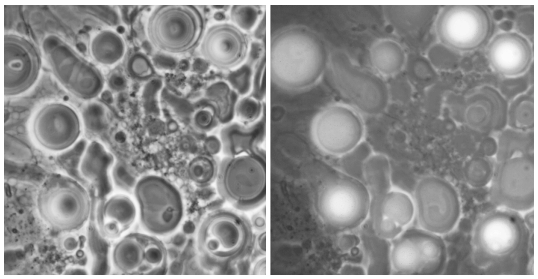

Figure 1. A protocell model system showing vesicles of decanoic acid-decanoyl monoglyceride (image on left) and the same field by fluorescence microscopy that reveals encapsulated polymers stained with a fluorescent dye specific for nucleic acids (right hand image).

Combinatorial Selection: Each compartment is unique in its composition and contents, and can be considered to be an experiment in a natural version of combinatorial chemistry that would be ubiquitous in prebiotic hydrothermal fields. Most such experiments would be inert, but a rare few protocells could capture polymers that increase their chance of surviving subsequent cycles (Figure 2). Combinatorial selection of encapsulated systems of polymers represents an experimentally testable model for understanding the origin of cellular life [2].

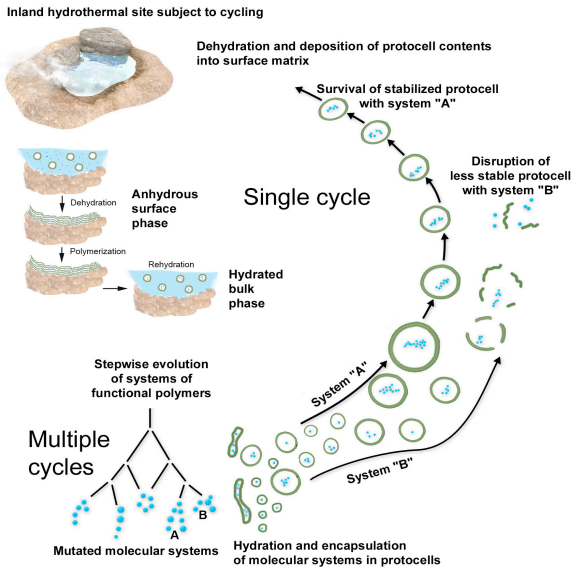

Figure 2.

Functional polymers can emerge in cycling conditions: We are not specifying the nature of the polymers, but if the solutes include monomers like nucleotides and amino acids, the polymers would resemble RNA and peptides, as well as possible complexes of RNA and peptides. Key functions of polymers might include stabilization of protocell membranes, insertion of pores that provide access to nutrients, catalyzed metabolism and heritable information.

References: [1] De Guzman V, et al. (2014) *J Mol Evol,* 78, 251-262. [2] Damer B. F. and Deamer D. W. (2015) *Life*, 5, 872-875.