A SIMPLE SOLUTION TO THE ENERGY FLUX REQUIRED FOR THE ORIGIN AND EARLY EVOLUTION OF BIOPOLYMERS. N. V. Hud, School of Chemistry and Biochemistry, NSF-NASA Center for Chemical Evolution, Georgia Institute of Technology, Atlanta, GA, USA, 30332; hud@gatech.edu.

Polymers (e.g., polypeptides, nucleic acids) are central to life, and most hypotheses regarding the origins of life include the early participation of polymers, such as the influential RNA world hypothesis. Thus, uncovering the origins of biopolymers is likely an important piece of the origin of life puzzle.

Within living cells biopolymers are synthesized and maintained in their far-from-equilibrium state by highly-evolved enzymes (e.g., synthetases, polymerases) and chemical energy (e.g., ATP, NADH). However, it stands to reason that the polymers involved in the origins of life came into existence before the advent of enzymes, and that the energy required for polymer formation was provided by geochemical or geophysical processes.

Regular hydration-dehydration cycles on the surface of the early Earth, such as those associated with day-night, tidal, and/or seasonal cycles, would have been the perfect source of energy and disequilibrium conditions for driving the synthesis and early evolution of biopolymers. The basic premise of this hypothesis is not new, as hydration-dehydration cycles have long been considered as possible drivers of prebiotic polymer formation [1-5]. Indeed, this hypothesis is consistent with the chemical structures of biopolymers, which are all, fundamentally, the product of condensation bonds between smaller molecular building blocks (Figure 1). Recent demonstrations that that hydration-dehydration cycles can efficiently drive the formation of the chemical bonds necessary to make biopolymers provide good reason to reconsider and to even expand upon this hypothesis [6-8]. While the formation of biopolymers in an aqueous environment is often considered to be a "problem" for prebiotic chemists [9], the details of the model to be discussed suggest that water and the water cycle actually provide a "solution" for prebiotic polymer formation and early evolution.

References:

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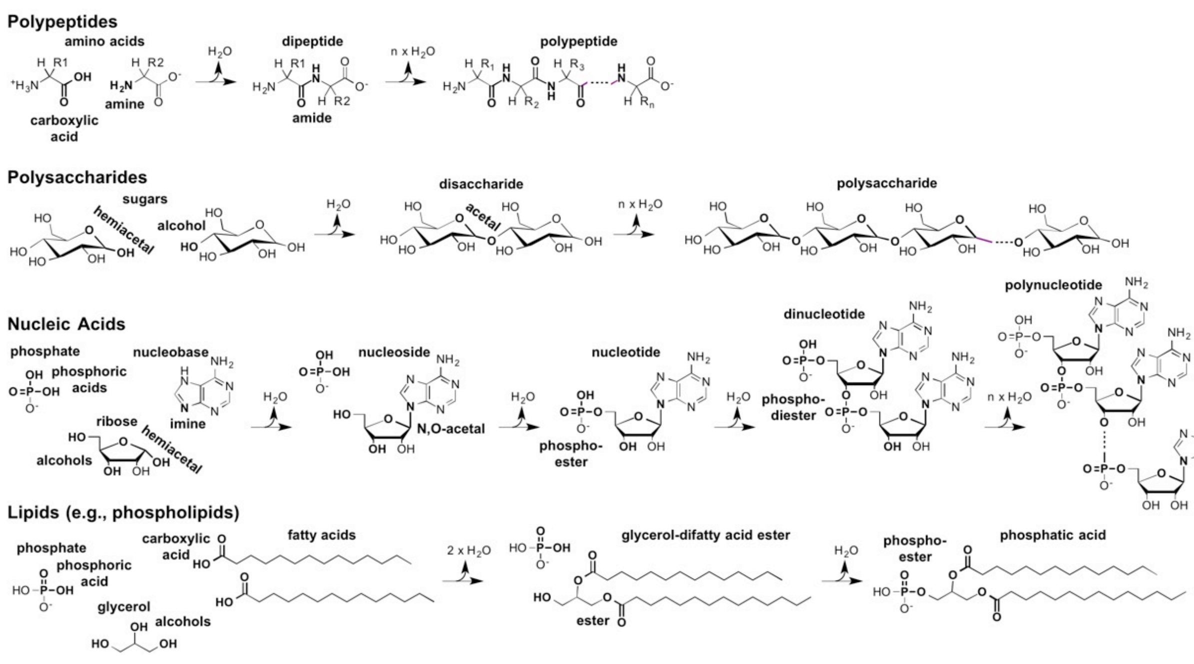

Figure 1. Chemical structures of the biological monomers, their associated oligomers and polymers, and the condensation reactions that join the monomers.