Viroids and viruses during evolution of life on Early Earth as model for Exoplanets?

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Abstract

The recent discovery of exoplanets with putative habitable zones which may be as frequent as 1025 stimulate the interest in the origin of life on the exoplanets but also on the Earl Earth (EE). Meteorites and missions to Mars or Moon teach us about their composition, and make us think about the origin of life in general. Prebiotic molecules such as amino acids, nucleosides, and fullerenes arrived from extraterrestric space and cyanobacteria and archaea are inhabitants of the EE. Fossilizations of microbes or viruses in laboratory simulators sharpen our understanding of possible extraterrestric microorganisms. What kind of life can we expect? Molecules which replicate, mutate, and evolve are signatures of life.
The simplest such biomolecules on Earth may be non-protein-coding (nc)RNA catalytic RNA, the ribozymes and viroids, which can fulfill many protein functions, including replication, evolution, and are a prerequisite for peptide synthesis. Ribozymes/viroids and RNA-peptide complexes can evolve to higher complexity, whereby the viruses are drivers of evolution. Giant viruses can become as big as bacteria suggesting a continuous transition from dead to living matter. Viruses are the most successful species on our planet. Even eukaryotic genomes consist to about 50% of retrovirus-like sequences. The bacterial/phage world and the virus/eukaryotic world reflshow many similarities. Viruses and phages evolved with their respective hosts protecting them by superinfection exclusions - which is equivlent to viruses supplying antiviral defence to their host. During evolution increase of complexity is considered as main driving force. However, also gene reduction or gene loss contributes to evolution as frequently underestimated forces. Under laboratory conditions protein-coding RNA can become non-coding suggesting "back-evolution".

Viroids are discussed here as potentially living stuctures without a genetic code as models for potentially other forms of life.
Ref: Broecker and Moelling, Geosciences (in press), Annals NY Acad Sci. (2019), Frontiers Microbiol (2019).

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