THE EFFECT OF CLAY MINERALS ON THE EVOLUTION OF RNA FUNCTION

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We will demonstrate the impact of biochemical-geological interactions on RNA evolution and discuss the implications for the origin of life on Earth. Although the conditions of the early Earth are incompletely understood, emergent life must have interacted to some degree with the lithosphere. Various empirical observations suggest that such interactions may have enhanced habitability. Clay minerals for example have been shown to adsorb [1], concentrate, protect [2] and catalyze the polymerization of RNA [3]. Interactions between geology and biology should therefore be considered when designing or interpreting origin of life experiments relating to the early Earth.

The capacity for RNA to both store information and catalyze reactions has led to a hypothesis that it served as the first functional biopolymer. In addition to several clues in extant biology *in vitro* evolution experiments have demonstrated the plethora of catalytic functions attainable by RNA offering further weight to this RNA world hypothesis. However, despite clear evidence of the sensitivity of RNA structures to the environment and the low probability of polypropylene tubes on the ancient Earth, the effect of geological surfaces on the evolution of RNA function has not been tested through in vitro evolution.

We will present data from parallel *in vitro* evolution experiments from random sequence populations to show that the presence of a geological surface affects the evolution of RNA function. Specifically we will show that the number of rounds until self-cleaving RNA molecules are enriched changes, that functional RNAs cleave at different locations, and that the sequence distribution is altered in the presence of montmorillonite clay. Additionally, we will demonstrate that changing the interlayer cation species significantly changes functional RNA populations. The differences between RNA functional populations subjected to Sodium and Magnesium homoioinic exchanged clay suggests a role for interlayer size or charge density on RNA function evolution.

Did RNA evolve in a polypropylene or geological world?

References:

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