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Dedicated to the Memory of Jim P. Ferris

Role of Minerals in the Formation and Preservation of RNA Oligomers in the Events Leading to the Origin of Life

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Introduction: Montmorillonite, a member of clay minerals with layer structure, catalyses the formation of RNA oligomers containing both 2',5'-linkages and 3',5'-linkages [1]. These synthetic oligomers, formed by montmorillonite catalysis, serve as template for the formation of complementary RNA oligomers [2]. Synthetic oligomers formed by montmorillonite catalysis containing exclusively 2',5'-linkages isolated from the mixture of 2',5'- and 3',5'-linked oligomers by enzymatic hydrolysis also serve as template producing not only 2',5'-linked oligomers, but also 3',5'-linked, i.e., RNA like oligomers [2].

Phyllosilicates, along with calcium carbonate, calcium sulfate, iron oxides and kaolinite have been identified on Martian surface. Biomolecules are constantly delivered onto Martian soil via meteorites, comets and interplanetary dust particles. The amount of organic material delivered to Earth has been calculated to be in the order of 2.4×10^8 g carbon/year [3, 4, 5]. On Earth, these molecules are protected from the harmful effects of radiation by the atmosphere, while on Martian surface they are exposed to the effects of UV and gamma radiation, and the effects of cosmic rays and particles due to thin atmosphere: 7 mbar.

We have irradiated the mixtures of building blocks of RNA and proteins with montmorillonite and other Martian analogue minerals with UV and gamma rays. The dose of UV radiation from a Xenon source received by the samples corresponded to only five days and the dose of gamma radiation from a Co-60 source corresponded to 500,000 years on Martian surface.

Analysis of these UV and gamma irradiated samples demonstrated that in the absence of minerals, the organic molecules were completely decomposed due to the effects of UV and gamma radiation. In the presence of minerals, the survival rate following the UV and gamma irradiation was about 98-99% and 20-10%, respectively [6, 7, 8, 9, 10].

These results clearly demonstrate the role of minerals for the formation and preservation of building blocks of RNA in the events leading to the Origin of Life.

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