

Nine requirements for the birth place of life and falsifiability to tackle with complexity science

*Shigenori Maruyama¹

1. Earth-Life Science Institute, Tokyo Institute of Technology

We listed up nine requirements for the first emergence of life on Earth, as follows: (1) an energy source (ionizing radiation and thermal energy); (2) a supply of nutrients (P, K, REE, etc.); (3) a supply of life-constituting major elements; (4) a high concentration of reduced gases such as CH₄, HCN and NH₃; (5) dry-wet cycles to create membranes and polymerize RNA; (6) a non-toxic aqueous environment; (7) Na-poor water; (8) highly diversified environments, and (9) cyclic conditions, such as day-to-night, hot-to-cold etc. Based on these nine requirements, we evaluate previously proposed locations for the origin of life on Earth, including: (1) Darwin's "warm little pond", leading to a "prebiotic soup" for life; (2) panspermia; (3) transportation from/through Mars, (4) a deep-sea hydrothermal system, (5) an on-land subduction-zone hot spring, and (6) a geyser systems driven by a natural nuclear reactor. We conclude that location (6) is the most ideal candidate for the origin point for Earth's life because of its efficiency in continuously supplying both the energy and the necessary materials for life, thereby maintaining the essential "cradle" for its initial development. Based on perspectives from world geology, we focus on the necessary environmental changes of for the Hadean Earth to drive a series of prebiotic processes that will allow life to emerge as a passive response to the forcing effects of environmental change.

To tackle with complexity science, represented by the research for the origin of life, science philosophy is a key. Especially falsifiability that proposed by Karl popper should be emphasized for better approach to unravel the mystery of complexity science.

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