EPSC Abstracts
Vol. 8, EPSC2013-334, 2013
European Planetary Science Congress 2013


# LOH-Hypothesis and MRH-Hypothesis: the resume of the twelve-year development

**V.E. Ostrovskii** (1) and E.A. Kadyshevich (2)
(1) Karpov Institute of Physical Chemistry, Moscow, Russia (vostrov@cc.nifhi.ac.ru), (2) Obukhov Institute of Atmospheric Physics RAS, Moscow, Russia (kadyshevich@mail.ru)

## Abstract

The present state of the LOH- and MRH-hypotheses of living matter origination and reproduction is given.

## 1. Introduction

The question on the boundary between living and inanimate (mineral) matters was considered by us in [1]. In our terminology, DNA and RNA are the simplest forms of the precellular living matter, while N-bases, riboses, nucleosides, and nucleotides are the living-matter simplest elements (LMSE). When formulating the Life Origination Hydrate Hypothesis (LOH-Hypothesis) and Mitosis and Replication Hydrate Hypothesis (MRH-Hypothesis), we proceeded from the understanding that the chemical processes that underlie living matter origination and its extended reproduction are thermodynamically conditioned, natural, and inevitable and are governed by similar physical and chemical laws. On this basis, we developed the notions on the mechanisms of living matter origination and reproduction in parallel.

## 2. Present state of the hypotheses

The hydrate (clathrate) mechanisms for the mitosis and binary fission and for the living matter origination were first proposed and grounded in [2, 3] (the term "MRH-Hypothesis" was introduced in [4]) and in [1] (the term "LOH-Hypothesis" was introduced in [1]), respectively. In [1], in the framework of the LOH-Hypothesis, a first realistic explanation for the DNA monochirality was given. The LOH-Hypothesis and MRH-Hypothesis were developed and published in [8]-[18] and [7, 9], respectively, and presented orally at the conferences [19]. According to the LOH-Hypothesis, LMSEs, DNA and RNA molecules, amino-acids and proto-cells originated repeatedly from $CH_4$, niters, and phosphates under the planet crust surface or seabed within the crystal cavities of the honeycomb $CH_4$-hydrate structure; the chemical processes passed slowly through all successive chemical steps in the direction of gradual decreasing in the Gibbs free energy of reacting systems. The LOH Hypothesis allows for answering the following questions. (1) In what phase did the LMSEs form? (2) From what substances did the LMSEs form? (3) By what mechanism did the N-bases, riboses, and nucleosides form? (4) Is Nature capable of synthesizing LMSEs from minerals with no external energy? (5) How had methane hydrate originated? (6) How had $CH_4$ and $NO_3^-$ met together? (7) Why no substance but $NO_3^-$ reacted with $CH_4$-hydrate? (8) How did DNA- and RNA-like molecules form from nucleosides? (9) Is there a relation between DNA and RNA formation, on the one hand, and the atmosphere composition, on the other hand? (10) Why do only five chemical elements usually enter the DNA and RNA composition? (11) Why are N-bases entering DNA and RNA similar in their composition and structure? (12) Why are N-bases and riboses limited in size? (13) Why are N-bases not identical? (14) Why do only five N-bases usually enter the DNA and RNA composition and why do other N-bases, such as xanthine, sometimes enter the DNA and RNA compositions? (15) Could D-ribose (DR), desoxy-D-ribose (DDR), thymine and uracil exist simultaneously in a reaction mixture containing $CH_4$ and niter? (16) How had it happened that the sequences of N-bases in DNA and RNA molecules are not random? (17) Why did Nature choose DR and DDR, but not their L-enantiomers or mixtures of enantiomers for DNA and RNA syntheses? (18) How did protocells originate?

The LOH-hypothesis is supported with numerous thermodynamic calculations; a number of field observations and C. Menor-Salvan's experiments count in its favour (see Refs. in [9]). It attracts interest of researchers. For example, Prof. H. Seligmann, the scientific editor of the book [7], wrote the following opinion in its preface about our Chapter: "This most interesting hypothesis develops a concept that escapes conceptions established through the force of habit, which frequently result in dominant, yet unproven intuitive truths. This hypothesis will doubtlessly produce new deep insights into every level of DNA associated processes, and probably also

general cell physiology, if given the deserved consideration and further developed."

## Acknowledgements

The work is supported by the Russian Foundation for Basic Research (project no. 12-05-01082-a).

## References

[1] Ostrovskii, V.E. and Kadyshevich, E.A.: Generalized hypothesis of the origin of the living-matter simplest elements, transformation of the Archean atmosphere, and the formation of methane-hydrate deposits, Physics-Uspekhi (Adv. Phys. Sci.), Vol. 50, pp. 175-196, 2007.

[2], [3] Ostrovskii, V.E. and Kadyshevich, E.A.: [2] Use of data on the polyacrylamide–water system in analyzing the equilibrium DNA–water structure, Russ. J. Phys. Chem., Vol. 74, pp. 1114-1124, 2000; [3] Hydrate model of the equilibrium DNA−water systems, Int. J. Nanosci., Vol. 1, pp. 101-121, 2002.

[4] Kadyshevich, E.A. and Ostrovskii, V.E.: Hypothetical physicochemical mechanisms of some intracellular processes: The hydrate hypothesis of mitosis and DNA replication, Thermoch. Acta, Vol 458, pp. 148–161, 2007.

[5]–[9] Ostrovskii, V.E. and Kadyshevich, E.A.: [5] Thermodynamics of formation of nitrogen bases and D-ribose from mineral substances, Thermochim. Acta, Vol. 441, pp. 69-78, 2006; [6] Life Origination Hydrate Hypothesis, OLEB, Vol. 39, pp. 219-220, 2009; [7] Mitosis and DNA replication and life origination hydrate hypotheses, in: H. Seligmann (ed.), DNA Replication – Current Advances, InTech, Rijeka, Croatia, pp. 75-114, 2011; [8] Life Origination Hydrate Hypothesis (LOH-Hypothesis), Life, Spec. Is.: The Origin of Life − Feature Papers, Vol. 2, pp. 135-164, 2012; [9] Life Origination Hydrate Hypothesis (LOH-Hypothesis): Original Approach to Solution of the Problem, Global J. Sci. Frontier Res. (A), Phys. and Space Sci., Vol. 12 (6), 1-36, 2012.

[10]-[14] Kadyshevich, E.A. and Ostrovskii, V.E.: [10] Hydrate hypothesis of living matter origination (LOH-hypothesis): Thermodynamic grounds of formation of living matter simplest elements from hydrocarbons and niter, J. Therm. Anal. Calor., Vol. 95, pp. 571-578, 2009; [11] Life origination hydrate hypothesis: What questions can be hypothetically answered at present? EPSC Abstr. Vol. 5, EPSC2010-5, 2010; [12] Hydrate hypothesis of living matter origination: Hypotheses of hydrocarbon-hydrate formation and living matter origination at the Earth, in: Degassing of the Earth: geotectonics, geodynamics, geofluids; oils and gas; hydrocarbons and life, GEOS, Moscow, Russ., pp. 195-198, 2010; [13] Life origination hydrate hypothesis (LOH-hypothesis): What markers testify to the possibility of the living-matter occurrence at exoplanets? EPSC-DPS Abstr., Vol. 6, EPSC-DPS2011-242-2, 2011; [14] Life Origination Hydrate hypothesis (LOH-hypothesis): $CH_4$-hydrate matrix as a necessary condition for life origin, EPSC Abstr., Vol. 7, EPSC2012-113, 2012 & EPSC Presentations, EPSC2012-113, 2012.

[15], [16] Ostrovskii, V.E., [15] Hypothesis of the natural gas abiotic origin in the context of living matter origination, in: Gas chemistry at the present stage of development, Moscow, Russ., pp. 35-69, 2010; [16] Hydrate hypothesis of living-matter origination and the problem of prolongation of life of living organisms, in book «Sci. potential - XXI», OAO «Rosintal», Obninsk, Russ., pp. 43-70, 2012.

[17] Dzyabchenko, A.V. and Kadyshevich, E.A.: Life Origination Hydrate Hypothesis (LOH-Hypothesis): theory and procedure of simulation of basic DNA units in hydrate structure, EPSC Abstracts, Vol. 8, EPSC2013-284, 2013.

[18] Kadyshevich, E.A., Dzyabchenko, A.V., and Ostrovskii, V.E.: Life Origination Hydrate hypothesis (LOH-hypothesis): computer simulation of rearrangement of different DNA components within $CH_4$-hydrate structure II, EPSC Abstr., Vol. 8, EPSC2013-285, 2013.

[19] Ostrovskii, V.E. and Kadyshevich, E.A.: European Planetary Science Congress, Madrid, Spain (2012); VII Int. Conf."Atmos. Phys., Climate and Environment", Moscow, (2012); III Int. Conf. "Biosphere Origin and Evolution", Crete, Greece (2011); 4th Europ. Conf. Chemistry for Life Sci., Budapest, Hungary (2011); Degassing of the Earth: geotectonics, geodynamics, geofluids; oils and gas; hydrocarbons and life, Moscow, Russia (2010); European Planetary Science Congress, Rome, Italy (2010); 21st IUPAC Intern. Conf. on Chemical Thermodynamics, Tsukuba, Japan (2010); Intern. Workshop on Chemical Evolution and Origin of Life, Roorkee, India (2010); Workshop of the Moscow Gubkin Oil and Gas State Univ., Moscow, Russia (2008); 12th Evolution. Biol. Meeting, Marseille, France (2008); Int. Conf. "Atm. phys. Clim. and health", Kislovodsk, Russia (2008); 4th Int. Conf. on the Origin of Life, Florence, Italy (2008); 5th Int. and 7th China-Japan Joint Symp. on Calorim. and Therm. Anal., Dalian, China (2008); 2nd Int. Conf. on "Adv. in Petrochem. and Polymers" (ICAPP2007), Bangkok, Thailand (2007); Series of lectures in the Tomsk State Univ., Russia (2006); 60th Ann. Calorim. Conf., Gaithersburg, USA (2005); 9th Int. Conf. "The Probl. of Solvation and Complex Formation in Solutions", Plyos, Russia (2004); Int. Conf. on Materials for Adv. Technol. (ICMAT 2003), Singapore, (2003); 12th Int. Symp. on Supramol. Chem. (ISSC 2002), Eilat, Israel (2002); Lecture in Depart. of Inorg. & Anal. Chem., Hebrew Univ. of Jerusalem, Israel (2002); 2nd Int. Conf. on Supramol. Sci. & Technol., Leuven, Belg. (2000); World Congr. on Biotechn., Berlin, Germ. (2000); 16th IUPAC Conf. on Chem. Thermodyn., Halifax, Canada (2000).