July 16 21, 2017 at UC San Diego, CA, USA

Title: Dynamics of Adenosine Monophosphate in Lipid and Salty Environment.

Loreto Misuraca[1,2], Francesca Natali[1,3], Laura da Silva[4], Judith Peters[1,5], Giuseppe Zaccai[1,6,7,8], David Deamer[9] and Marie Christine Maurel[4]

[1] *Institut Laue Langevin (ILL), 71, Avenue des Martyrs, 38000 Grenoble, France*
[2] *Dipartimento di Fisica e Chimica, Università degli Studi di Palermo, Viale delle Scienze, Ed. 17, 90128 Palermo, Italy*
[3] *Consiglio Nazionale delle Ricerche, Istituto Officina dei Materiali (CNR-IOM), Research Unit in Grenoble, 71, Avenue des Martyrs, 38000 Grenoble, France*
[4] *Institut de Systematique, Évolution, Biodiversité (ISYEB), UMR 7205 CNRS-MNHN-UPMC-EPHE Sorbonne Universités, CP50, 57 rue Cuvier, 75005 Paris, France*
[5] *Université Grenoble Alpes (UGA), UFR PhITEM, 621 Avenue Centrale, 38000 Grenoble, France*
[6] *Institut de Biologie Structurale (IBS), 71, Avenue des Martyrs, 38000 Grenoble, France*
[7] *Commissariat à l'énergie atomique et aux énergies alternatives (CEA), 17 Avenue des Martyrs, 38054 Grenoble, France*
[8] *Centre National de la Recherche Scientifique (CNRS), 25 Avenue des Martyrs, 38000 Grenoble, France*
[9] *University of California, Santa Cruz, CA 95060, USA*

One of the fundamental questions, which concern the Origin of Life studies, is how the first nucleic acids were synthesized starting from the monomeric constituents, in a prebiotic environment. The question is also highly relevant since it could give additional information to solve the controversy between “Lipid world” and “RNA world” hypotheses[1]. Recent studies reported evidences on a non-enzymatical polymerisation of mononucleotides inserted in confining environments such as lipid multilayers and monovalent salts[2,3,4], pushing toward an “RNA world”. The free energy necessary to allow the phosphodiester bond synthesis in such systems is given by Hydrothermal (HD) Cycles of hydration-dehydration at high temperature, conditions which commonly occur in volcanic hydrothermal fields nowadays, and were likely to be ubiquitous on the early Earth environment. Hence life could have been emerged into volcanic “hydrothermal fields”, rather than oceanic “hydrothermal vents”[5].

The effects of the confining environments (lipid multilayers and crystal salts) on the mononucleotide (AMP) structure have been recently studied[6,7], and the results showed that the mononucleotides in these systems are forced to lie in a particular “entangled” structure, which may give a higher probability of occurrence of the phosphodiester bond synthesis.

However, what it is still unknown is how both the confining environments and the water affect the mononucleotide mobility itself, giving degrees of freedom to enable the needed molecular rearrangements. To this purpose, we performed Neutron Scattering experiments at the large scale facility “Institut Laue Langevin” in Grenoble, France. Quasi-Elastic (QENS) and Elastic (ENS) data analysis, which gave us insights about the dependence on the hydration level of the AMP dynamics (whose results have been recently published[8]), will be presented, together with new preliminary results on the particular geometry of each hydrogen motions, detected in the pico-to-nanosecond timescales.

[1] Paleos, C.M. ; Trends Biochem. Sci. 2015, 40, 487–488.
[2] Rajamani, S.; Vlassov, A.; Benner, S.; Coombs, A.; Olasagasti, F.; Deamer, D. Orig. Life Evol. Biosph. 2008, 38, 57–74.
[3] Deamer, D. Trends Biochem. Sci. 2015, 40, 487–488.
[4] Da Silva, L.; Maurel, M.-C.; Deamer, D. J. Mol. Evol. 2015, 80, 86–97.
[5] Damer, B.; Deamer, D. Life 2015, 5, 872-887.
[6] Toppozini, L.; Dies, H.; Deamer, D.W.; Rheinstädter, M.C. PLoS ONE 2013, 8, e62810.
[7] Himbert, S.; Chapman, M.; Deamer, D.W.; Rheinstädter, M.C. Sci. Rep. 2016, 6, 31285.
[8] Misuraca, L.; Natali, F.; da Silva, L.; Peters, J.; Demé, B.; Ollivier, J.; Seydel, T.; Laux-Lesourd, V.; Haertlein, M.; Zaccai, G.; Deamer, D.; Maurel, M.C. Life 2017, 7, 2.