STUDIES OF NUCLEOBASES BINDING MECHANISMS TO MINERALS, THEIR STABILITY AND REACTIVITY UNDER PREBIOTIC AND SPACE-LIKE CONDITIONS. Teresa Fornaro[1], John Robert Brucato[2], Malgorzata Biczysko[3], Vincenzo Barone[4], Cecile Feuillie[5], Dimitri Sverjensky[6] and Robert M. Hazen[7], [1]Scuola Normale Superiore, piazza dei Cavalieri 7, 56126 Pisa, Italy, INAF – Astrophysical Observatory of Arcetri, L.go E. Fermi 5, 50125 Firenze, Italy, and Geophysical Laboratory, Carnegie Institution for Science, 5251 Broad Branch Road NW, Washington, DC 20015, USA, teresa.fornaro@sns.it, [2]INAF – Astrophysical Observatory of Arcetri, L.go E. Fermi 5, 50125 Firenze, Italy, jbrucato@arcetri.astro.it, [3]Physics Department, and International Centre for Quantum and Molecular Structures, Shanghai University, 99 Shangda Road, Shanghai, 200444 China, and Consiglio Nazionale delle Ricerche, Istituto di Chimica dei Composti OrganoMetallici (ICCOM-CNR), UOS di Pisa, Area della Ricerca CNR, Via G. Moruzzi 1, I-56124 Pisa, Italy, malgorzata.biczysko@pi.iccom.cnr.it, [4]Scuola Normale Superiore, piazza dei Cavalieri 7, 56126 Pisa, Italy, vincenzo.barone@sns.it, [5]Geophysical Laboratory, Carnegie Institution for Science, 5251 Broad Branch Road NW, Washington, DC 20015, USA, cfeuillie@ciw.edu, [6]Johns Hopkins University, Department of Earth and Planetary Sciences, 3400 N Charles St, Baltimore, MD 21218, USA, sver@jhu.edu, [7]Geophysical Laboratory, Carnegie Institution for Science, 5251 Broad Branch Road NW, Washington, DC 20015, USA, rhazen@ciw.edu.

Introduction: The passage from geochemistry to biochemistry probably resulted from the combination of multiple complex phenomena between organic and inorganic systems, and studying how organic molecules interact with minerals may be a step forward in the comprehension of the unsolved question of the origin of life[1,2]. Investigations on the molecular binding mechanism to mineral surfaces, the stability and reactivity of molecule-mineral complexes under plausible prebiotic and space-like conditions would give key inputs to figure out the physico-chemical phenomena that led to the emergence of life on Earth as well as the molecular chemical evolution in space[2,3].

In particular, the study of the adsorption of nucleic acid components, such as nucleobases, on mineral surfaces may have important implications in the RNA world model of the origin of life[4,5]. Regarding mineral matrices, silicates and metal oxides are relevant mineral substrates to investigate due to their abundance and their possible role as sinks, catalysts and templates for prebiotic reactions[6]. Among these, Mg-containing minerals are rather interesting because the inorganic chemistry of magnesium might have played a key role in prebiotic geochemistry[2,3,7].

The high complexity underlying such processes has been faced both experimentally by investigation of the thermodynamics of the adsorption process, characterization of the nature of molecule-mineral interactions through infrared spectroscopy measurements, study of the photostability of molecule-mineral complexes through UV irradiation experiments, and theoretically through computational spectroscopy, surface complexation studies and molecular modeling of mineral-molecule interactions[2,3,8,9,10,11,12].

Such results contribute to unravel the role of minerals in the transformation/preservation of biomolecules in abiotic environments, shedding light on the intricate prebiotic geochemical processes on the early Earth and on the chemical evolution of complex molecular systems in space.

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