Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11981

Potential mechanisms to synthesize amino acids from nitrous oxide and carbon monoxide through large molecular weight precursor

XIAOFENG ZANG[1] AND YUICHIRO UENO[1,2]

[1]Tokyo Institute of Technology
[2]JAMSTEC

Presenting Author: sherryzxf1121@gmail.com

The question whether the source of building blocks of first life on primitive Earth were formed in terrestrial or extraterrestrial is still under debate. Earlier studies of chemical evolution considered a scheme that simple organic molecules (like amino acids), abiotically produced from the atmosphere, condense into the primordial soup and then polymerized to give more complex molecules [1], and many experimental studies proved that organic acids and amino acids can be produced from gas mixtures simulating the possible primitive atmosphere [2][3][4]. On the other hand, extraterrestrial amino acids have been observed in comets [5] and carbonaceous chondrites (CCs) [6], and concentrations of amino acids from CCs increased after acid hydrolysis [7]. A new sight that amino acids are present in the form of amino acid precursors instead of free amino acids, is supported by many experimental studies using high energy particles [8][9]. Our previous study demonstrated that amino acids such as glycine, alanine, and serine can be synthesized from gas mixtures of N_2O, CO and H_2O under UV irradiation even without metal catalysts [10], though the mechanism of those products remains unclear. In this paper, we further show that the products of the UV experiment also include some large molecular weights compounds that could be a potential amino acid precursor synthesized through photochemistry. In order to evaluate the role of the macromolecules, this study analyzed the sample using acid hydrolysis. Based on the results, we will discuss possible mechanism to synthesize amino acid from N_2O and CO, which may occur also in terrestrial environment.

Reference

[1] Miller and Orgel, (1974), Prentice-Hall, Englewood Cliffs. [2] Miller (1953), Science 117, 528–529. [3] Groth and Weyssenhoff (1960), Planet Space Sci 2, 79–85. [4] Sagan and Khare (1971), Science 173, 417–420. [5] Elsila et al., Meteoritics & Planetary Science 44, 1323e1330. [6] Pizzarello et al., 2006, Meteorites and the Early Solar System II 625e651. [7] Glavin et al., (2020) Chem Rev 120, 4660–4689. [8] Kobayashi et al., (1999), Adv Space Res 24(4), 461-4. [9] Kasamatsu et al. (1997a), Bull Chem Soc Jpn 70, 1021–1026. [10] Zang et al., (2022), Astrobiology, ahead of print (DOI:10.1089/ast.2021.0064)