Supply of organic compounds from early atmosphere into hydrosphere

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Photochemical reaction of reducing atmosphere is a plausible source of simple organic compounds that could initiate prebiotic synthesis of complex organic molecules [1]. In contrast to the other possible sources like Miller-Urey-type lightning and delivery of organics by extraterrestrial impact, UV-photochemistry could be a steady input of prebiotic compounds everywhere on the surface of the Earth, thus has a potential to sustain further network of reactions in the ocean. Also, photolysis of H_2O likely produce redox gradient or disequiliblium at the surface of the ocean or lake. Thus, UV induced photochemistry particularly at the interface between atmosphere and hydrosphere is worth considering as a driver for successive prebiotic reaction network. In order to predict the photochemical production qualitatively and quantitatively, we have conducted a series of laboratory experiments of CO_2-CO-H_2O system. The results show that formic acid is effectively produced from CO and accumulated in a liquid phase, when photolyzing CO/CO_2 atmosphere under the presence of liquid water. The result is contrast to previous experiment simulating only gas-phase photochemistry that indicated formaldehyde production [2] [3]. The final species and their production rate depend largely on redox state of the system and actinic flux particularly shorter than 200 nm. These results suggest that not only atmospheric composition but also hydrosphere and its redox state should be the key to control the fate of organic molecules supplied from early atmosphere into hydrosphere.

[1] Chyba & Sagan (1992) *Nature* **355**, 125-132. [2] Pinto *et al.* (1980) *Science* **210**, 183-185. [3] Bar-Nun & Hartman (1978) *OLEB* **9**, 93-101.