Detection of nucleobases and dipeptides in organic residues formed by photochemical reactions in interstellar ice analogs

YASUHIRO OBA[1]*, YOSHINORI TAKANO[2], HIROSHI NARAOKA[3], NAOKI WATANABE[1], AKIRA KOUCHI[1]

[1]ILTS, Hokkaido Univ., Sapporo, Hokkaido 060-0819 Japan (*correspondance: oba@lowtem.hokudai.ac.jp)

[2]Dept. Biogeochem., JAMSTEC, Yokoshuka, Kanagawa 237-0061 Japan

[3]Dept. Earth Planet. Sci. & Research Center for PTOC, Kyushu Univ., Fukuoka, Fukuoka 819-0395 Japan

How large can molecules become and what kinds of biologically important molecules can be synthesized before the onset of life are fundamental issues of interest in astrobiology and astrochemistry communities. With this regard, a number of laboratory experiments have been performed since the early 80's and demonstrated that various kinds of complex molecules such as amino acids and sugars can be formed at low temperatures by photochemical reactions in interstellar ice analogs consisting of simple molecules [1]. In the present study, we aimed at detecting new classes of organic compounds in the photochemically processed interstellar ice analogs by using a high-performance liquid chromatograph (HPLC) coupled with a high-resolution mass spectrometer (HRMS) .

We firmly detected for the first time six nucleobases and five dipeptides in organic residues formed after the photolysis of ice mixtures consisting of H_2O, CO, NH_3, and CH_3OH at the ratio of 5:2:2:2 at 10 K, followed by heating to room temperatures, The yields of the products (in ppm) ranged from 4×10^{-2} to 4 for nucleobases and 4 to 42 for dipeptides. Note that we did not perform experiments specifically aimed at producing those molecules. Rather, since this kind of photolysis of interstellar ice analogs has been performed for several decades, nucleobases and dipeptides would have been produced in many of previous similar experiments. One of the key factors to detect those molecules in the present study is the use of the HPLC/HRMS which enabled ones to unambiguously detect nucleobases and dipeptides among various kinds of their structural isomers. Another factor for the detection of nucleobases would be the temperature at which the photolysis takes place. We strongly expect that the temperatures where CO can adsorb on the reaction substrate such as 10 K might be suitable for the production of nucleobases in the interstellar ice analogs.

[1]Öberg (2016) *Chem. Rev.* **116**, 9631–9663.