Production of Amino acids by impact reactions using a light-gas gun as simulation experiment of asteroid impacts in space.

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A variety of organic compounds are abiologically produced in space. This is confirmed by the detection of organic compounds from interstellar molecule clouds. This is also confirmed by the identification of organic compounds in carbonaceous meteorites such as the Marchison meteorite. Organic compounds produced by impact reactions can be stored in the surfaces and subsurfaces of planets and scattered into space. Titan, the moon of Saturn, is similar to the primitive Earth and has attracted much attention. In the previous simulation experiments, production of many carbon clusters was confirmed. However, production of amino acids by impacts experiment simulating asteroid impacts has not yet been made clear. Therefore, we carried out the laboratory simulation experiment using a 2-stage light-gas-gun, and tried to find organic compounds such as amino acids from carbon soot under a nitrogen-rich atmosphere [1]. The experiment was carried out at ISAS/JAXA. We used a polycarbonate bullet 7.1 mm in diameter or a stainless steel bullet 3.2 mm in diameter. The bullet was accelerated to about 6.5 km/s and injected into a pressurized target chamber. At the end of the large target chamber, the pressurized target chamber was set. At the end of the pressurized target chamber, an iron target (an ice + iron target or an ice + hexane + iron target or a tholin + iron target) was set. After the impact, the soot was carefully collected. A part of the soot was refluxed in 50 ml of the pure water for 8 hours at 100 ℃. The water was filtered the soot and condensed by heating. A part of the filtered sample was hydrolyzed. A part of the soot was also hydrolyzed, extracted and filtered. Those prepared samples were analyzed by a HPLC. Those HPLC data are compared with those of standard amino acid solution including 17 amino acids and blank. Peaks of glycine and alanine were detected in the sample which was refluxed. Peaks of serine and leucine were detected in the sample which was hydrolyzed. The sample which was extracted from the hydrolyzed soot indicated sharper signals of amino acids. It is estimated that approximately 10^{-6}-10^{-4} g/mg of glycine, alanine, serine and leucine were included in the carbon soot produced by the impact reaction, when the ice + hexane + iron target was used. Because the amount of soot is not uniform, it is better to measure more samples. We think that chains of large organic compounds in the sample were broken down by hydrolysis, and the more peaks were detected. Hydrolysis, in the case of this experiment, may reacts incompletely when the quantity of the soot is too large. The numerical value in quantitative analysis may be loose when the quantity of the soot is too small. A hot plume is produced by the impact under the nitrogen rich atmosphere. In the hot plume, C_2 and N_2 molecules are reacted during the cooling process to produce CN molecules. They could cause reactions to produce amino acids.
Ref.[1] : K. Okochi,T. Mieno et al.: Orig. life. Evol. Biosph (2015) **45**: 195-205.

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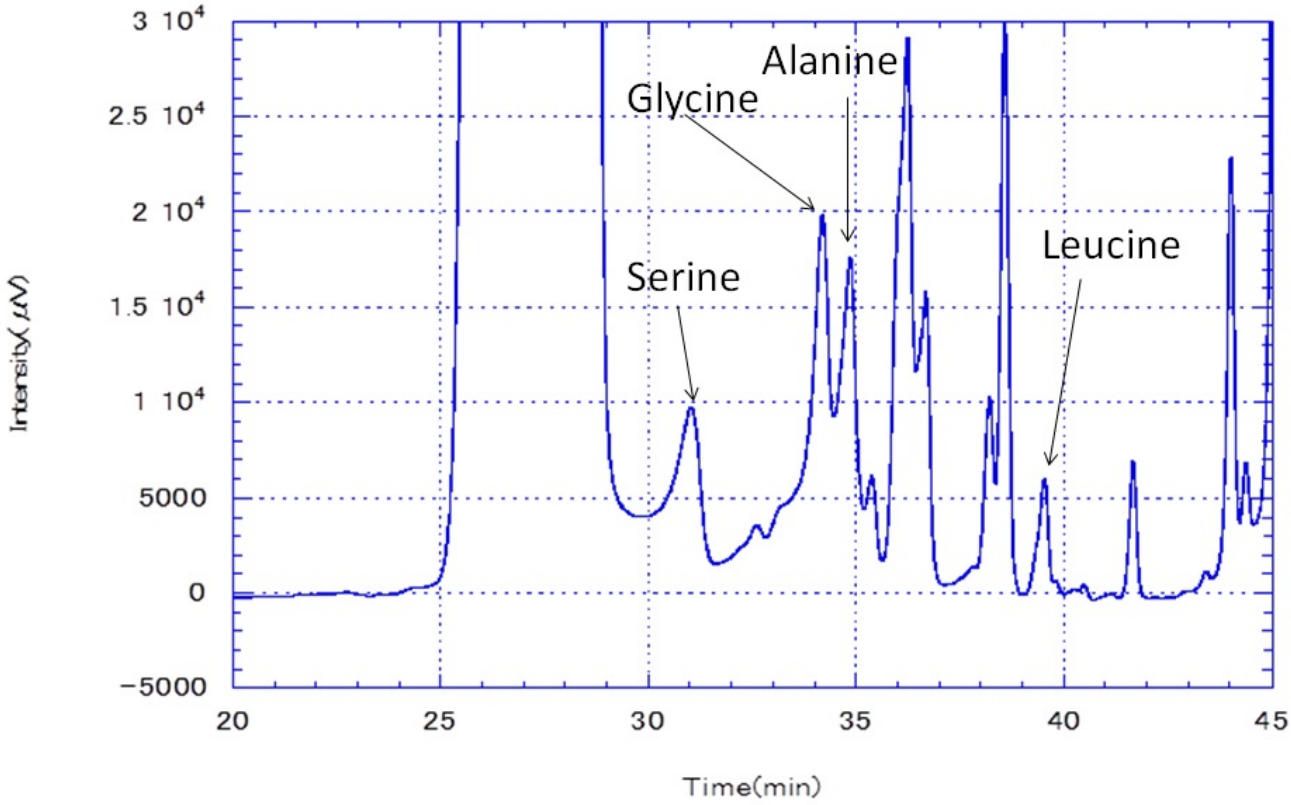

Fig. Example of HPLC data.

