Making molecules

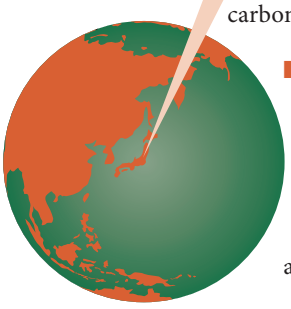
Yoshihiro Furukawa and colleagues stuck to their guns in an attempt to recreate life on the early Earth.

What was the objective of the work?
We wanted to test the hypothesis that meteoric impact events in the early nitrogen-rich atmosphere and ocean produced organic molecules. Determining the origin of organic molecules sufficient for the emergence of life, in terms of both abundance and variety, is key to understanding the creation of life on Earth.

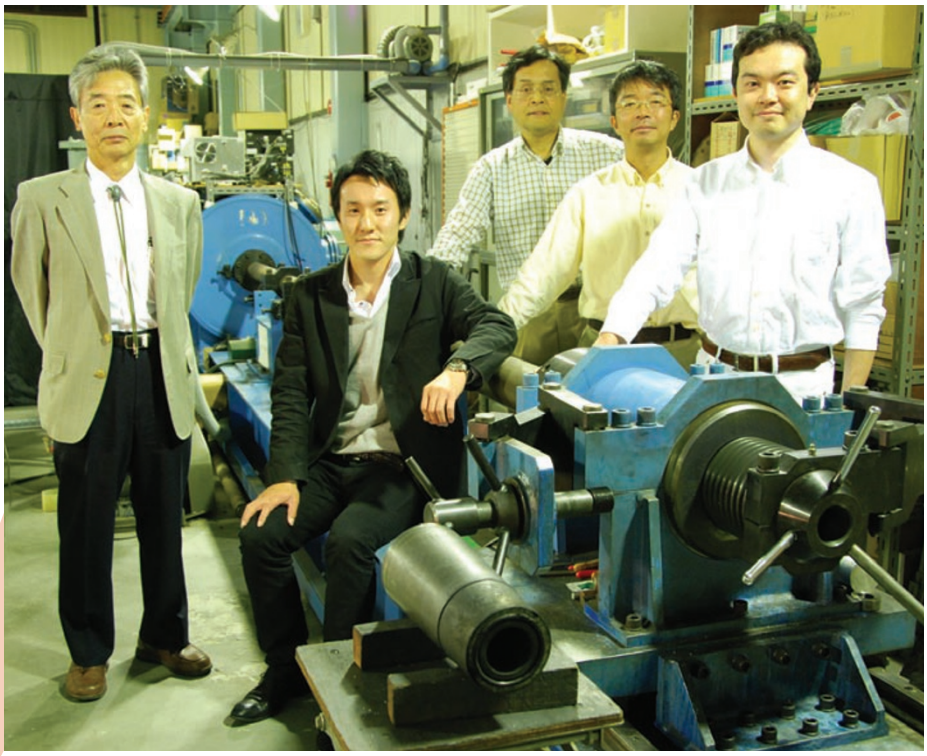
What samples were you after?
In order to test this hypothesis, we used a propellant gun to fire high-speed projectiles into a mixture of water, solid carbon, iron, nickel and gaseous nitrogen. We found numerous organic molecules in the early stages of the experiment, but we couldn't rule out the possibility that they were contaminants. For this reason we decided to use a naturally scarce isotope of carbon, ^{13}C, as the solid carbon source; in this way we could verify that the organic molecules produced really were experimental products.

Did you encounter any difficulties?
We had great difficulty handling the water used in the shock-recovery experiments, because the pressure created by the water, once vaporized by the impact, burst the sample containers. To overcome this we ran numerous tests in which we changed the speed of the propellant and the amount of water used. Eventually we hit upon the right combination, but it was a rather protracted process. To make extra sure we didn't lose any moisture, we also developed a gas-tight container to prevent any leaks.

Did you have encounters with dangerous animals?
Bacteria, the source of biomolecule contamination, posed the greatest threat. We had to prevent significant contamination at all costs, as it would have spoilt the data even with the use of ^{13}C carbon sources.



What was the highlight of the work?
The highlight had to be the moment we found amines and carboxylic acids in our samples. Initially we were only interested in amino acids — and when we couldn't find these after the first round of experiments we got ready to move on to the next set of experiments. However, one day one of our colleagues was flicking through the chromatograms and noticed remarkably high concentrations of several amines and carboxylic acids. It was then that we realized that shock impact events really could create organic molecules, but our attention had been so focused on amino acids that we almost missed this discovery.



The projectile gun that Furukawa and colleagues used to create shock impact events.

Did you learn anything new about yourself or your team members?
It took an incredibly long time to prepare the manuscript because of extended discussions regarding the implications of the results. During this time we received very skeptical feedback from our colleagues about the discovery that organic molecules could be synthesized during shock impact experiments. However, everyone in the team turned out to be very resilient, and at times rather stubborn, which proved invaluable for the completion of the manuscript.

Did the study give you any ideas for future research projects?
In the present experiments we wanted to see whether it was possible to produce simple organic molecules during shock impact events, and we analysed carboxylic acids, amines and amino acids. Next, we aim to improve extraction and analytical methods so that we can detect other, more complex, organic compounds, such as alcohols, aldehydes and nitriles. Using these data we hope to gain insight into the geological events that may have allowed life to flourish on the early Earth.

This is the backstory to the work by Y. Furukawa and co-workers, published on page 62 of this issue.