How are Amino Acids Altered in Meteorite Parent Bodies by Hydrothermal Processes?

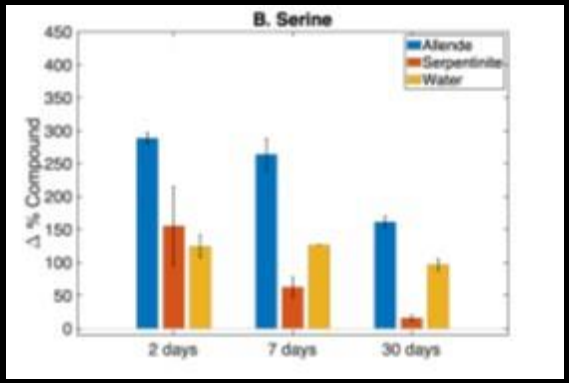
Although amino acids are found in planetary materials, it is not yet clear how they formed or how they have changed with time and with varying local conditions in a comet or asteroid.

A team of scientists from the Astrochemistry Laboratory (691) and the Planetary Environments Laboratory (699) performed experiments to better understand the formation and alteration of amino acids found in extraterrestrial samples like meteorites.

The team first simulated the formation of amino acids in space by exposing the types of ices present in interstellar clouds to radiation. Then they placed these amino acids in hot liquid water and tracked changes in their abundances in the presence of minerals meant to simulate conditions experienced in the interiors of asteroids or other planetary bodies.

These findings have ramifications for future studies of meteorites and returned samples from space: even when their origins in ices are similar, parent-body processes play a significant role in defining the distributions of amino acids detected in extraterrestrial samples. Importantly, the minerals present can have a strong impact, even allowing better preservation of the amino acid in some cases. This suggests that amino acid abundances may vary within a sample based on localized mineral inclusions.

The Murchison meteorite (shown) as well as returned cometary and asteroidal samples have all be found to contain amino acids and other chemical compounds used by life on Earth. [Image credit: NASA]



Amino acid retention depends on the material in which it is contained. The sequence on the right shows that the amino acid serine was destroyed at different rates when heated in the presence of water alone (yellow), when the mineral serpentinite was added (orange) or when a pulverized sample of the Allende meteorite was added (blue). In this case, the meteorite powder seemed to better preserve the amino acid.

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