Meteorites a rich source for primordial soup

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Image credit: NASA

The organic soup that spawned life on Earth may have gotten generous helpings from outer space, according to a new study. Scientists at the Carnegie Institution have discovered concentrations of amino acids in two meteorites that are more than ten times higher than levels previously measured in other similar meteorites.

This result suggests that the early solar system was far richer in the organic building blocks of life than scientists had thought, and that fallout from space may have spiked Earth's primordial broth.

The study, by Marilyn Fogel of Carnegie's Geophysical Laboratory and Conel Alexander of the Department of Terrestrial Magnetism with Zita Martins of Imperial College London and two colleagues, will be

published in *Meteoritics and Planetary Science*.

Amino acids are organic molecules that form the backbone of proteins, which in turn build many of the structures and drive many of the chemical reactions inside living cells. The production of proteins is believed to constitute one of the first steps in the emergence of life. Scientists have determined that amino acids could also have formed in some environments on the early Earth, but the presence of these compounds in certain meteorites has led many researchers to look to space as a source.

The meteorites used for the study were collected in Antarctica in 1992 and 1995 and held in the meteorite collection at the NASA Johnson Space Center in Houston, Texas. Antarctica is the world's richest hunting ground for meteorites, which are naturally concentrated in so-called blue ice regions and held in cold storage by the ice.

For the amino acid study, the researchers took small samples from three meteorites of a rare type called CR chondrites, thought to contain the oldest and the most primitive organic materials found in meteorites. CR chondrites date from the time of the solar system's formation. During an early phase of their history the meteorites were part of a larger "parent body," such as an asteroid, which later was shattered by impacts.

The analysis revealed that while one sample showed a relatively low abundance of amino acids, the other two meteorites had the highest ever seen in primitive meteorites—180 and 249 ppm (parts per million). Other primitive meteorites that have been studied generally have amino acid concentrations of 15 ppm or less. Because organic molecules from extra-terrestrial sources have ratios of carbon isotopes different from those of Earthly biological sources, the researchers were able to rule out contamination as a factor in their result.

“The amino acids probably formed within the parent body before it broke up,” says Alexander. “For instance. ammonia and other chemical precursors from the solar nebula, or even the interstellar medium, could have combined in the presence of water to make the amino acids. Then, after the break up, some of the fragments could have showered down onto the Earth and the other terrestrial planets. These same precursors are likely to have been present in other primitive bodies, such as comets, that were also raining material onto the early Earth.”

Ref. "Indigenous amino acids in primitive CR meteorites." *Meteoritics and Planetary Science*. Available for free download at astro-ph. (arxiv.org/abs/0803.0743v2)

Source: Carnegie Institution