Impact processes in the planetary systems are crucial for the origin of life

V S Surendra*

Physical Research Laboratory Ahmedabad India

*surendra@prl.res.in

As of now, we know life as chemical building block of organic molecules. Molecules such as amino acids and nucleobases are known to be synthesized in primitive conditions from simple molecules containing hydrogen, carbon, nitrogen, oxygen. Various studies suggest that meteorites, comets, and other solar system bodies are rich in organics and harbour important precursors of life such as amino acids. These prebiotic organics were transported to Earth as well as other Solar System bodies through impact events. Impacts are ubiquitous in the Solar System. Impacts induced shock creates a high temperature and pressure which provides chemical pathways for large scale molecular synthesis. With evidence of impact history over Solar System bodies, the impact-induced shock could be a profound source for complex chemistry. Previous studies suggest that biomolecules such as amino acids can be synthesized by such a process [1,2]. So it is mandatory to understand the fate of these organics in those extreme conditions. In this regard, our laboratory simulation provides a novel experimental technique to simulate impact-shock conditions, utilizing a shock tube. We present for the first time, experimental evidence of complex macroscale structure formation due to shock processing of amino acid utilizing a 7-meter-long shock tube in the laboratory, over the post-shock temperature range of 1500 to 8000 K maintained for 2 ms. The SEM micrographs of shock processed residue suggest that amino acids polymerized to form ordered structures of μm to mm size consisting of complex morphology such as threads, ribbons, and tubes, twisted and folded and with complex textures on it. Well defined patterns resembling the bunch of petals, buds, and leaves were also observed. Single amino acids like glycine and a combination of two amino acid mixtures, four amino acid mixtures, and 18 amino acid mixtures were exposed to impact in the shock tube. More complex patterns tend to appear as we increase the number of amino acids in the mixture. The tendency of amino acid towards the formation of complex macroscale structure provides tentative evidence for the evolution of the building blocks of life under impact-shock condition. Further investigations are under pipeline which will enhance our understanding of this field.

References:

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[2] Martins, Z., Price, M. C., Goldman, N., Sephton, M. A., Burchell, M. J. (2013) *Nature Geoscience*, 6, 1045-1049.