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Shock compression of synthetic amino acid - silica gel complex modeling for comet nucreus

MURAI, Takuro[1] ; OKUNO, Masayuki[2*] ; OKUDERA, Hiroki[2] ; ARASUNA, Akane[1] ; MASHIMO, Tsutomu[3] ; CHEN, Liliang[3] ; MIZUKAMI, Tomoyuki[2] ; ARAI, Shoji[2]

[1]Graduate School of Kanazawa University, [2]Kanazawa University, [3]Kumamoto University

Some amino acids were found in comet coma particle and Murchison meteorite [1,2]. These reports may suggest a possibility that basic materials of primitive life on the earth were formed in the space and delivered to the earth.

Greenberg et al. (1997)[3] reported the almost comets are made of organic compounds, silicates and ice. On the other hand, silica gel contains a non crystalline SiO_4-$_n(OH)_n$ framework with water molecules. So, silica gel is a suitable model material for comet. In this study, in order to investigate the stability of amino acid (L-serine) in the comet nucleus during the impact to the earth, synthetic amino L-serine - silica gel complex materials were shock compressed and the structure change of the recovered samples were analyzed by X-ray diffraction measurements, IR and Raman spectroscopies. Shock compression experiments were performed at 8.2, 10.9, 19.7 and 26.9 GPa.

By Raman spectroscopic analyses, it was indicated that synthetic complex materials include two types of L-serine such as crystalline L-serine and hydrated L-serine. Obtained Raman spectra of shocked materials show the L-serine crystal was disappeared and hydrated L-serine molecules survived at 19.7 GPa of shock pressure. Therefore, the sample at 19.7 GPa includes only hydrated L-serine molecules. This may indicate that intermolecular hydrogen bonds of L-serine molecules may be broken by shock compression with water molecule.

The shock pressure of 19.7 GPa is consistent with the estimated impact pressure of about 19% comets to the earth reported by Blank et al. (1999) [4]. This fact may indicate that a possibility for the basic materials of primitive life on the earth were formed in the space and delivered to the earth.

References

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Keywords: comet, amino acid, silica gel, shock compression