Hypervelocity impact experiments with liquid water and polycarbonate in an open system

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Unravelling the origin(s) of prebiotic organic materials that constituted protocells on the early earth is important to constrain the conditions for the emergence of life and the chemical diversity of life in the universe. One proposes that biologically relevant organic materials were mostly produced through atmospheric chemistry and mineral-water interactions from simple compounds (N_2, CO_2, CO, CH_4) available in the early earth, whereas the other proposes that a significant amount of extraterrestrial organic materials, that were produced in the early solar system, protoplanetary disk, and molecular clouds, were delivered to the early earth and served as key components of protocells [1]. If the latter hypothesis is correct, most of the extraterrestrial organic materials in meteorite should have been survived from thermal decomposition during hypervelocity impact into the Hadean ocean (>3 km/s) [2], since geological evidences suggest that the ocean was already present but the continent was almost absent in the Hadean earth [3, 4]. However, the fate of extraterrestrial organic materials during oceanic impact is poorly understood due to the lack of experimental knowledge about the physicochemical processes associated with the hypervelocity impact of meteorite into liquid water. To evaluate whether extraterrestrial organic materials could have been vital components of protocells on the early earth, we are developing a methodology of experimental impact in an open system that can simulate the physicochemical processes during oceanic impact most faithfully. In this meeting, we report preliminary experimental results that polycarbonate impacted into liquid water at a velocity of 6 km/sec.

[1] Kobayashi (2013) *Origins of Life: Chemical evolution on Earth and Elsewhere, Kodanshya, Japan*. [2] Bottke *et al*. (2000) *Nature* **485**, 78–81. [3] Komiya *et al*. (2015) *Techtonophysics* **662**, 40–66. [4] Kemp *et al*. (2010) *Earth Planet. Sci. Lett.* **296**, 45–56.