CAPTURE OF COSMIC DUSTS ON THE INTERNATIONAL SPACE STATION BY THE JAPANESE ASTROBIOLOGY MISSION (TANPOPO).
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Introduction: Cosmic dusts (interplanetary dust particles (IDPs) and micrometeorites) are the most primitive solar system materials available to us [1]. Some types of cosmic dusts that are linked with the comets [2] contain higher amounts of carbon ranging from ~12% [3] up to more than 90% [4, 5], than carbonaceous chondrites (~2%) [6]. In addition, the high mass flux of 40,000 tons/year cosmic dusts onto the surface of the Earth [7] support that cosmic dusts could have played a role as one of the significant sources of exogenous delivery [e.g., 8].

To date, most of the IDPs and micrometeorites studied have been collected at stratosphere and Antarctica. The Japanese Astrobiology mission, Tanpopo, seriously starts an experiment to collect the micrometeorids on the International Space Station (ISS). It is a great advantage to collect the pristine cosmic dusts without atmospheric entry heating and terrestrial contamination. As a pioneer study, the mineralogy, petrography, and oxygen-isotope compositions of a cosmic dust captured by a low-density silica aerogel (0.03 g/cm^3) on the ISS have been reported [9]. In Tanpopo mission, for our better understanding of what kind of organic compounds could have been delivered to the early Earth, we attach great importance on the chemical analyses of organic compounds in the captured dusts, as well as mineralogy and isotopic analyses. Moreover, we will use a lower-density silica aerogel (0.01 g/cm^3) which has been originally developed for this mission [10]. After the arrival to ISS in 2015, the samples captured by silica aerogels will be returned to the Earth, once a year, three times in total three times (in 2016, 2017, and 2018).

Grand-based experiments: One concern about capturing cosmic dusts on the ISS is a possible alteration of organic matter in IDPs upon their high velocity impact to the aerogel. As a ground-based experiment, we have conducted a laboratory experiment of aerogel capture of Murchison meteorite powder (~ 500 μg) of a particle diameter of 30-100 μm at 4 km/s using a two-stage light gas gun at JAXA/ISAS, for evaluating the extent of alteration of organic matter in the meteorite. Micro-FTIR imaging detected the regions of absorptions of aliphatic carbons (CH_3 at 2960 cm^{-1} and CH_2 at 2920 cm^{-1}) within the Murchison terminal particles captured by aerogel, indicating the survival of organics through the high velocity impact of 4 km/s. However, the spectral intensities of aliphatic carbons in the terminal particles are slightly lower than those in the pre-shot Murchison meteorite, implying a loss of volatiles. Micro-Raman analyses detected D- (~1365 cm^{-1}) and G- bands (~1590 cm^{-1}), which are derived from carbonaceous matter, from the Murchison terminal particles. The D- and G- band widths and positions showed similar values to those for pre-shot Murchison meteorite. Thus, the intact aromatic structures is retained via the aerogel capture. Further evaluation for the higher impact velocity (e.g., 6 km/s) will be required, since the average velocity of cosmic dusts in Low Earth Orbit is 14-20 km/s and the ISS moves at 8 km/s.

Strategies of sample analyses: Like Stardust mission, we will extract aerogel "keystones" for the analyses of soluble organic compounds including amino acids and their precursors by 2D-HPLC, LC-MS, as well as the analyses of the impact tracks by synchrotoron x-ray microtomography, ToF-SIMS, and micro-FTIR, respectively. Organic chemistry, mineralogy, petrology, and isotopic cosmochemistry of the extracted particles from the aerogels will be comprehensively investigated by a coordinated analytical flow including micro-FTIR, micro-Raman, STXM/XANES, ToF-SIMS, nanoSIMS, TEM, FIB/SEM, FE-SEM, XRD, EBSD, and FE-EPMA.

References: [1] Alexander C.M.O'D. et al. (2007) *GCA* 71, 4380-4403. [2] Messenger S. et al. (2006) *In: Meteorites and the Early Solar System II* (*MESSII*) (eds. Lauretta D. S. and McSween, H. Y., Jr.) Univ. of Arizona, USA, pp. 187-208. [3] Thomas K. L. et al. (1993) *GCA* 57, 1551-1566. [4] Nakamura, T. et al. (2005) *Meteor. Planet. Sci.* 40, A110. [5] Yabuta H., et al. (2012) *Lunar Planet. Sci.* XLIII, #2239. [6] Pizzarello S. et al. (2006) *In: MESSII*, pp. 625-651. [7] Love S. G. and Brownlee D. E. (1993) *Science* 262, 550-553. [8] Chyba C. and Sagan C. (1992) *Nature* 355, 125-132. [9] Noguchi et al. (2011) *EPSL* 309, 198–206. [10] Tabata M. et al. (2011) *Biol. Sci. Space*, 25, 7-12.