THE RYUGU GRAIN ANALYSIS: APPROACH BY THE PHASE 2 CURATION "TEAM KOCHI".

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Hayabusa2 space craft successfully conducted a touchdown onto the surface of the asteroid Ryugu on Feb. 2019. According to the camera monitoring during the touchdown, the sample catcher most likely contains the asteroid surface regolith. Reports by the Near-IR Spectrometer (NIRS3) on Hayabusa2 spacecraft presented that the asteroid Ryugu may consist of either CM chondritic materials or shocked/heated carbonacesous chondrites [1–3]. Matsuoka et al. pointed out that the low albedo of the asteroid Ryugu could be explained by a combination of C-rich material, grains size, porosity and space weathering effects on the asteroid surface materials [3]. Unique Ryugu materials require to take extra care of vulnerability and terrestrial contamination (i.e., atmospheric water/air, organics) during sample curation, sample transportation and analysis.

Phase 2 curation team "Kochi" was authorized by the steering committee of the the Astromaterial Science Research Group of JAXA in 2017. The team "Kochi" consist of members from the Kochi Institute for Core Sample Research, JAMSTEC (KOCHI), JASRI/SPring-8, UVSOR Synchrotron/National Institutes of Natural Sciences, Institute for Molecular Science, National Institute of Polar Research (NIPR) and Tokyo Metropolitan University. We will conduct an *in-depth* analysis of a few grains by the *state-of-the-art* instruments/techniques, and in parallel with the initial analysis team led by the Hayabusa2 project.

Returned samples from Ryugu will provide an opptunity to investigate the origin and nature of the Solar System as well as the asteroid-meteorite connections, space weathering processes, water-rock interaction, evolution of organics and small asteroidal body formation in the Solar System. For the systematic analysis of the Ryugu grains consisting of hydrous/unhydrous minerals and organics, we have developed universal sample holders (the Okazaki cell, the Kochi grid and the Kochi clamp) for a linkage analysis utilizing FIB, TEM, STXM-NEXAF and NanoSIMS for minimizing terrestrial contaminations and sample lost or breakage [4, 5]. A sample transport vessel (FFTC: facility to facility transfer container) under vacuum or inert gas was also established [5, 6].

We will conduct a coordinated synchrotron based-CT (SPring-8) – 3D-XRD (SPring-8) – FIB (JAMSTEC KOCHI) – STXM (UVSOR Synchrotron) – NanoSIMS (JAMSTEC KOCHI) – TEM (JAMSTEC KOCHI) analysis to obtain complex structure inside of the sample, light element/isotope images to obtain their spatial distributions, speciation of elements: type of bonding, chemical species, redox state and ultra-fine textural observation: mineralogy and crystallography in fine-grained mineral and organic assemblages in few tens to hundreds of the micrometer-scale Ryugu samples. In addition, we recently have installed glove boxes in three institutes of SPring-8, UVSOR Synchrotron and JAMSTEC KOCHI. Most of our experiments including sample preparation, mounting and analysis can be done under the N_2 conditon. Okazaki et al. [7] pointed out that most outer layer materials (amorphous phases, space wethering layer materials) of the Itokawa particles are susceptible to the chemical reaction and decomposition with oxygen and water in the atmosphere. We are expecting that there may be small amount of extraterrestrial water (as hydrous mineral phases) and organics in 100 mg of the Ryugu samples. To prevent these materials from reactions with a terrestrial atmosphere (atomospheric water, oxygen and organics) the anti-terrestrial atmosphere exposure system may help to obtain original characteistics of the Ryugu grains.

We will apply the coordinate analyses to the Antarctic micrometeorites, CM and CI chondrites (the NIPR meteorite collections) as analogues of the Ryugu sample [e.g., 5, 8].

References: [1] Kitazato K. et al. (2019) *Science* 364:272–275. [2] Hiroi T. et al. (2019) *50th LPSC* (LPI Contrib. No. 2132), abstract#1129. [3] Matsuoka et al. (2019) *50th LPSC* (LPI Contrib. No. 2132), abstract#1534. [4] Ohigashi T. (2019) in preparation. [5] Uesugi K. (2019) in preparation. [6] Uesugi M. et al. (2019) this meeting. [7] Okazaki R. et al. (2017) *Space Sci. Rev.* 208:107–124. [8] Ito M. et al. (2018) *Hayabusa symposium 2018*, abstract#30.