JAXA'S ASTROMATERIALS SCIENCE RESEARCH GROUP AND CURATION FACILITY FOR HAYABUSA AND HAYABUSA2 ASTEROIDS SAMPLE RETURN MISSION. M. Abe[1,2], T. Yada[1], T. Okada[1,3], K. Sakamoto[1], M. Yoshitake[1], Y. Nakano[1], T. Matsumoto[1], N. Kawasaki[1], K. Kumagai[1], S. Matsui[1], M. Nishimura[4] and H. Yurimoto[1,5], [1]Japan Aerospace Exploration Agency, [2]SOKENDAI, The Graduate University for Advanced Studies, [3]University of Tokyo, [4]Marin Works Japan LTD, [5]Hokkaido University (abe@planeta.sci.isas.jaxa.jp, abe.masanao@jaxa.jp).

Introduction: Astromaterials Science Research Group (ASRG), established in 2015, is continuing curatorial work for Hayabusa returned samples and developing the curation facility for Hayabusa2 returned samples. JAXA curation facility of Extraterrestrial Sample Curation Center (ESCuC) was completed in 2008 for Hayabusa returned samples acceptance. Its conceptual examination was started in 2005, and its specification was decided in 2007 by the advisory committee of the Curation Facility [1]. After receiving the Hayabusa returned samples and curatorial work for them, we are going to research using these samples, such as international announcement of opportunity.

Special feature of JAXA curation facility: The feature of JAXA curation facility is the ability to be able to observe, and take out and keep a precious return sample scientifically, without being exposed to the atmosphere. Thereby, for example, noble-gas analysis and space weathering observation were enabled while they are difficult in the meteorite research due to the influence of terrestrial contamination. Moreover, in this facility the handling of the 10-micrometer sized particle is also possible using electrostatically controlled micromanipulation system installed in a clean chamber under N_2 atmosphere. The curation facility in which handling of such small samples without exposing to the atmosphere is available is the only one in the world [1].

Initial description of Hayabusa sample: About 700 particles of Hayabusa sample of 10 to 300-micrometer size are collected until now. Optical and SEM/EDS observations have been carried out in almost all those particles, and these Hayabusa samples information are catalogued. Statistical discussion in the initial description was executed using the mineral composition of the 1 to 40-micrometer sized particles scratched by Teflon spatula. Using these information, it is judged that recovered samples were returned from asteroid Itokawa [1,2].

Detailed analyses of Hayabusa sample: In the preliminary examination phase started about six months after Hayabusa return, detailed analyses by XCT/XRD, TEM, EPMA, SIMS, FTIR, NAA, noble-gas-MS, ToF-SIMS, etc. were conducted [2]. In these examinations, they are resolved the relationship between S-type asteroid and ordinary chondrite, the figure of pre-rabble-pile body, and the occurrence of the space weathering phenomenon. After the sample distribution to NASA following the preliminary examination, international AO analyses have been started and offer of the analysis opportunity to the global researchers has been performed from 2012.

In the international AO research, chronological studies such as an Ar-Ar isotope age, firstly performed for Itokawa samples [3], and the investigations of the formation history of small bodies are progressing.

From FY 2016, sample request for advanced research will be open through the year. Reviews of 4th Intl. AO have just finished and 6 proposals were selected for sample allocation.

Furthermore, in the curation facility, consortium researches on the rare particles which are not distributed for the international AO are also advanced, and the effort to obtain the maximum scientific result about a precious sample is made.

Hayabusa2 mission: Hayabusa2 spacecraft will bring back surface samples of the near-Earth C-type asteroid (162173) Ryugu at the end of 2020. Because the C-type asteroids, of which reflectance spectra are similar to carbonaceous chondrites, are highly likely to record the long history of the solar system from the beginning to planet formation including the supply of volatiles to terrestrial planets, the main scientific goals of the Hayabusa2 mission are the investigations of (a) the origin and evolution of the solar system, and (b) the formation process and structure of the asteroid.

Curatorial work of Hayabusa2 returned samples: After receiving the returned samples of the Hayabusa2 mission, prior to the initial analysis, the phase-1 curation (sample description) will be done at the JAXA curation facility. Along with the initial analysis, the phase-2 curation of returned samples will be done for integrated thorough analysis and description of samples to build a sample database and to obtain new scientific perspective from thorough analysis of samples. The phase-2 curation will be done both in JAXA and also in several research institutes outside JAXA led by the JAXA curation facility.

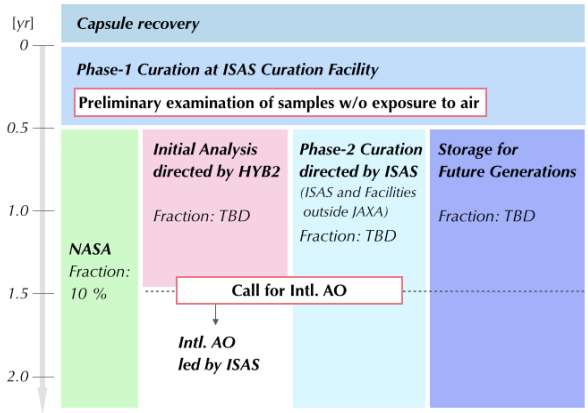

Fig.1 Shcedule of curatorial work and sample distribution plan for Hayabusa2

Preparation of curation facility for Hayabusa2: We have started examination of receiving facility of Hayabusa 2 return sample. We are going to launch the specification examination committee of the curation facility for Hayabusa 2 with the preliminary examination team of Hayabusa 2 project. Since Hayabusa 2 is a sample return mission from C-type asteroid, it is necessary to ensure recovery of the volatile matter from the samples containing organic matter and water. Moreover, since recovery of the mm-sized particles which was not able to be performed by Hayabusa is expected, the technical development (for example sample cutting) of the handling method for the large particles is required.

In Hayabusa 2, more attention is paid to contamination control than in Hayabusa mission. Final cleaning of the sample catcher was executed in the curation facility and its cleaning level is known. Moreover, the contaminant has been monitored with contamination coupon during the construction of the sampling devices.

Conceptual design of clean chambers for Hayabusa2: After examination of receiving facility for Hayabusa2, we almost fixed the specification and conceptual design of the clean chambers for Hayabusa2. The clean chambers are composed of mainly two parts. One is CC3 which are mostly in vacuum environment, the other is CC4 in ultra-pure nitrogen gas environment. CC3 consists of three rooms, the CC3-1 is used for opening sample container, the CC3-2 is used for sampling in high vacuum environment, and the CC3-3 is used for sample storage. CC4 is composed of two rooms, the CC4-1 is for micrometer-size samples handling and sealing of sample holders, which is similar to Hayabusa CC2 clean chamber, the CC4-2 is for millimeter-size samples handling.

Schedule before receiving of returned samples: We have started detailed design of clean cambers and clean room for the receiving facility from this year. Their manufacture will be started by the middle of next year and it will be completed by the middle of 2018. After the establishment of the curation facility for Hayabusa2, we will execute the rehearsal of the operation to succeed in the curatorial work of the returned samples of Hayabusa2 until the return of the Hayabusa2 spacecraft to the Earth.

References: [1] Yada et al. (2014) *Meteorit. Planet. Sci.*, 49, 135–153. [2] Nakamura et al. (2011) *Science*, 333, 1113–1116. [3] Park et al. (2015) *Meteorit. Planet. Sci.*, 50, 2087-2098.