PREPARATION FOR CURATION OF SAMPLES RETURNED FROM THE C-TYPE ASTEROID RYUGU BY HAYABUSA2. T. Yada[1], M. Abe[1], A. Nakato[1], K. Yogata[1], K. Sakamoto[1], M. Nishimura[1], T. Okada[1], Y. Nakano[2], M. Yoshitake[1], K. Kumagai[3], A. Iwamae[3], S. Furuya[1], S. Tachibana[1,4] and H. Yurimoto[1,2], [1]Inst. Space Astronaut. Sci., Japan Aerosp. Explor. Agency (JAXA), 3-1-1 Yoshinodai, Chuo, Sagamihara, Kanagawa 252-5210, Japan (yada@planeta.sci.isas.jaxa.jp), [2]Dept. Earth Planet. Sci., Grad. Sch. Sci., Hokkaido Univ., Kita 8, Nishi 5, Kita, Sapporo, Hokkaido 060-0808, Japan, [3]Marine Works Japan Ltd., 3-54-1 Oppamahigashi, Yokosuka 237-0063 Japan, [4]UTOPS, Grad. Sch. Sci., Univ. Tokyo, 7-3-1 Hongo, Bunkyo, Tokyo 113-0033, Japan.

Introduction: Hayabusa2 spacecraft, which had launched in 3 Dec. 2014, reached the C-type near-Earth asteroid (162173) Ryugu on June 27, 2018, and has been observing the asteroid with a series of remote-sensing instruments with successful deployments of two rovers MINERVA-II-1 and a lander MASCOT [1, 2]. The spacecraft plans to perform the first touchdown for sampling at the beginning of this year. It will depart from the asteroid at the end of 2019, and return its re-entry capsule encapsulating Ryugu's surface samples back to the Earth at the end of 2020 [2].

In parallel with the spacecraft operation, JAXA has been preparing for the curation of the samples returned from the asteroid [3, 4]. Here we summarize updates of the preparation status of the curation activity.

Preparation status for a clean room and sample-handling chambers: A new class-1000 clean room for Hayabusa2-returned Ryugu samples was established in Sept. 2017 with a grating floor to establish laminar airflow [4]. Installation of newly developed sample-handling clean chamber system (CCs) for sample handling was accomplished by last October (Fig. 1). The entire sample-handling system consists of five chambers (CC3-1, CC3-2, CC3-3, CC4-1 and CC4-2). The returned sample container will be first connected to CC3-1 for opening in vacuum, and will be transferred to CC3-2 for vacuum-handling of samples. The container will be then transferred into CC3-3, where the sample handling environment will be changed from vacuum to purified nitrogen. Further handling of samples will be done in purified nitrogen in CC4-1 and CC4-2.

New features of the Hayabusa2 sample container: Because C-type asteroids are likely to be parent bodies of hydrated carbonaceous chondrites [5], volatile components such as water and organic matter are one of essential science target for sample analysis [6]. To return volatile-containing samples without contamination of terrestrial volatiles, a new metal sealing system was developed for the Hayabusa2 sample container [6, 7, 8] (Fig. 2). Although the sealing system using two Viton O-rings for the Hayabusa container could not prevent terrestrial air contamination [9], the metal sealing system can keep the air contamination less than 1 Pa for 100 hour in the air [7, 8].

Furthermore, any volatiles released from the samples inside the container can be extracted by putting the container to the gas extraction vacuum line prior to the container opening before installation into CC3-1 [7, 8].

Curation and preliminary examination processes of Ryugu samples: Considering the new features of the Hayabusa2 sample container, a flowchart for initial handling of Ryugu samples was revised from that for Hayabusa [10] (Fig. 3).

The re-entry capsule will first be transferred to the quick look facility nearby the landing point. After the capsule being secured by removing a battery, the box for electronics, and a part of heat shield, the sample container will be cleaned up and connected to the gas sampling system in a clean booth to extract gaseous volatiles inside the container.

The sample container will then be disconnected from the gas sampling system keeping the interface part, and will be delivered together with tanks containing extracted volatiles to the JAXA Extraterrestrial Sample Curation Center (ESCuC) with being kept in a nitrogen atmosphere.

A heat shield, made of carbon fiber reinforced plastic, on the top of the container will be remove at the class 10,000 clean room at ESCuC. The container surface will then be cleaned and connected to the container opening system. An outer lid of the container, springs and a non-explosive actuator for the metal sealing system, and a frame for the container latches will be removed sequentially. The container opening system with the sample container will then be installed into CC3-1.

The container will be opened in CC3-1 to take out the sample catcher that encapsulates Ryugu grains. The extracted sample catcher will be transferred to CC3-2. The sample catcher has three chambers for keeping samples collected at different surface locations separately [7, 8], and a lid of the chamber for samples obtained at the first sampling location will be taken apart to pick up a small fraction (<5 %) of grains. The picked-up samples will be kept in CC3-2 for future generations under a vacuum condition.

After the transfer of the catcher to CC3-3 under a vacuum condition, a gate valve between CC3-2 and CC3-3 will be closed. CC3-3 will then be purged with

purified nitrogen. The catcher will be transported to CC4-1 and CC4-2 to take out grains from three chambers of the container. As the initial description called 'phase-1' curation work under purified nitrogen environment in CC, the grains will be weighed, observed with a stereomicroscope, and examined with visible to near-infrared spectrometers in CC4-1 and CC4-2.

Sample distribution plan: Some fractions of Ryugu samples are planned to be delivered to the initial sample analysis team of the Hayabusa2 project and phase-2 curation teams in six months after the capsule recovery [3]. Ten-percent of the samples will be delivered to NASA after 12 months from the capsule recovery following the MOU (Memorandum of Understanding) between JAXA and NASA. In 18 months after the capsule recovery (summer in 2022), the sample catalogue will be released with the international announcement of opportunity for the samples. The samples will be available to the community through a proposal-based competition.

Concluding remarks: Functional checks of the sample handling system and rehearsals of receiving and handling samples will be initiated in April, 2019. The sample handling system will be reconditioned in early 2020 based on feedbacks from the preparation activities to be ready for the sample return in late 2020.

References: [1] Watanabe S. et al. (2018). *AGU 2018 fall meet.*, presentation #P21A-02. [2] Watanabe S. et al. (2017) *Space Sci. Rev. 208,* 3–16. [3] Abe et al. (2017) *LPS XLVIII*, abstract #1760. [4] Yada T. et al. (2018) *81st Ann. Meet. MetSoc,* abstract #6117. [5] Vilas et al. (2008) *Astron. J. 135*, 1101–1105. [6] Tachibana S. et al. (2014) *Geochem. J., 48,* 571-587. [7] Sawada T. et al. (2017) *Space Sci. Rev. 208,* 81-106. [8] Okazaki R. et al. (2017) *Space Sci. Rev. 208,* 107-124. [9] Okazaki R. et al. (2011) *LPS XLII*, abstract #1653. [10] Yada T. et al. (2014) *Meteoritics Planet. Sci. 49*, 135-153.

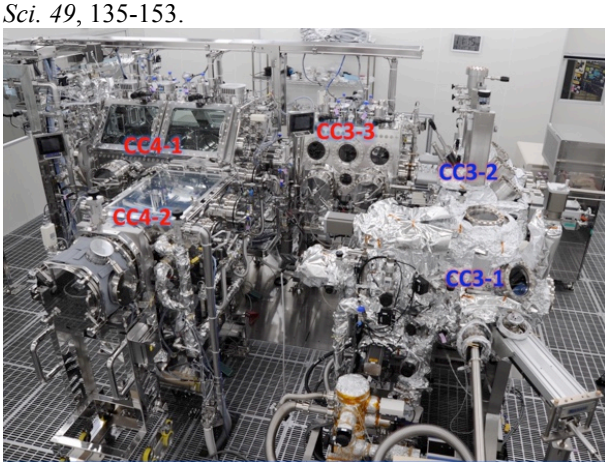

Fig. 1. A bird-view image of the sample-handling system for Ryugu samples. The system consists of five chambers; CC3-1, CC3-2 CC3-3, CC4-1 and CC4-2.

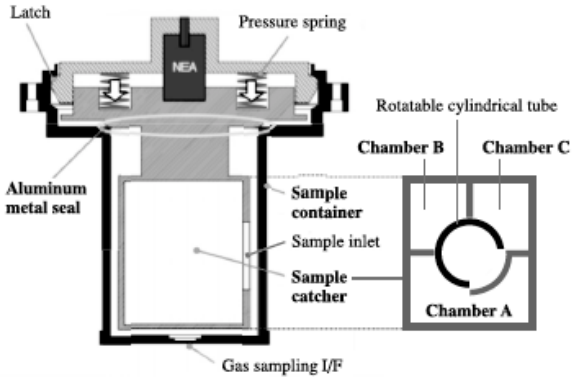

Fig. 2. A schematic illustration of the Hayabusa2 sample catcher and container, which is referred from Fig. 6 of [6].

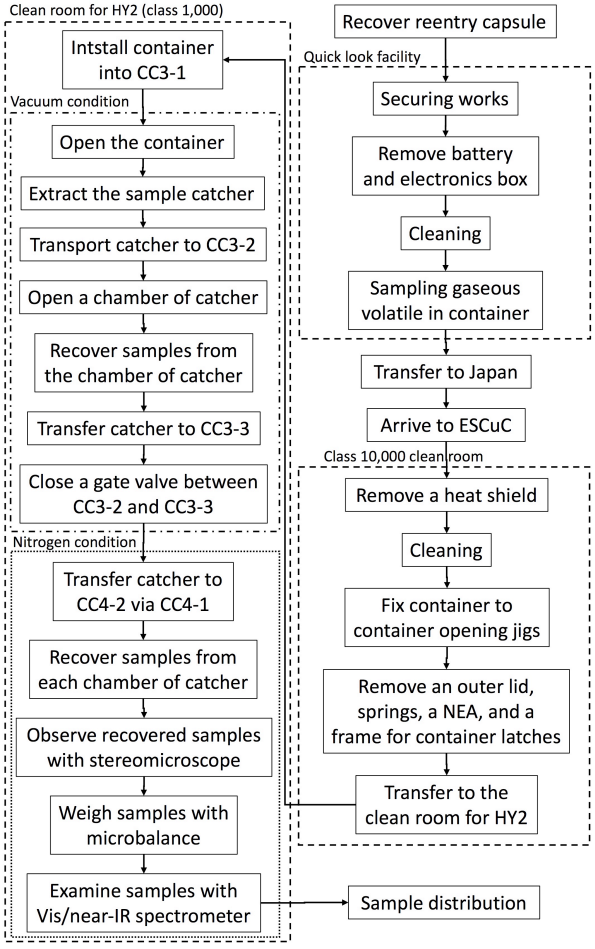

Fig. 3. A flowchart of curation and preliminary examination processes from the capsule recovery to sample distribution.