

Asteroid explorer, Hayabusa2, reporter briefing

December 6, 2021

**JAXA Hayabusa2 Project
ISAS Astromaterials Science Research Group**



Overview & Table of Contents



Overview

- Report on curation activities and future plans
 - 2021/6: samples distributed to the sample analysis teams. The analysis is proceeding as planned, and the results are set to be reported next spring.
 - 2021/11/30 CST: 10% of the sample collected from Ryugu were distributed to NASA under the Memorandum of Understanding (MOU) between NASA & JAXA.
 - Early spring 2022 : sample catalogue will be available to the public in preparation for the international open call in summer 2022.
- Spacecraft operation status
 - Continuation of the Extended Mission.

Contents

0. Celebrating the 1st anniversary of the return to Earth (Y. Tsuda)
 1. Report from the curation team (T. Usui)
 2. Status of spacecraft operations (M. Yoshikawa)
 3. Ryugu sample public release (M. Yoshikawa)



1. Curation activity status and future plans



Analysis of the samples distributed in June is proceeding as planned, and the results are set to be reported next spring.

2020/12

Phase1: Understanding the overall appearance of the sample, initial description of the first distributed sample (within 6 months of return)

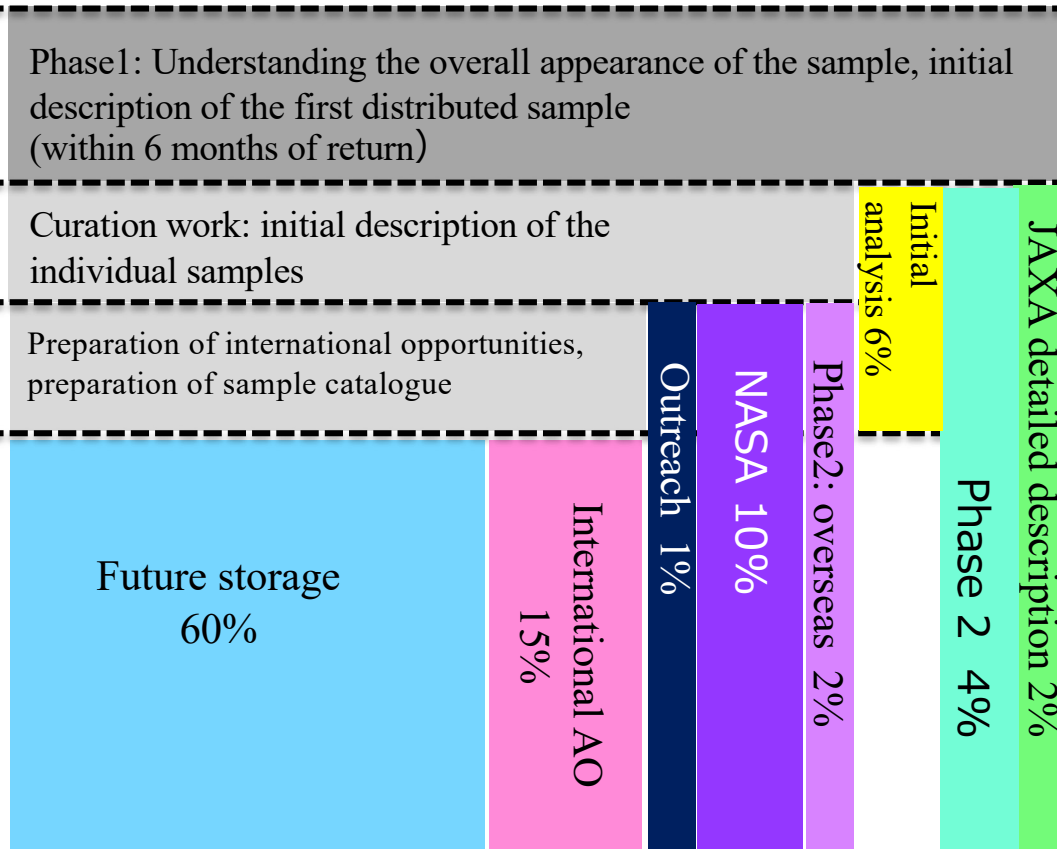
2021/6

Curation work: initial description of the individual samples

2021/12

Preparation of international opportunities, preparation of sample catalogue

2022/6



Total sample : ~5.4 g

- Chamber A : 3.2 g
- Chamber B : <0.1 g
- Chamber C : 2.0 g
- Other : ~0.2 g

Sample distribution in June

- Initial analysis : ~0.3 g
- Phase 2 : ~0.2 g

(credit: JAXA)

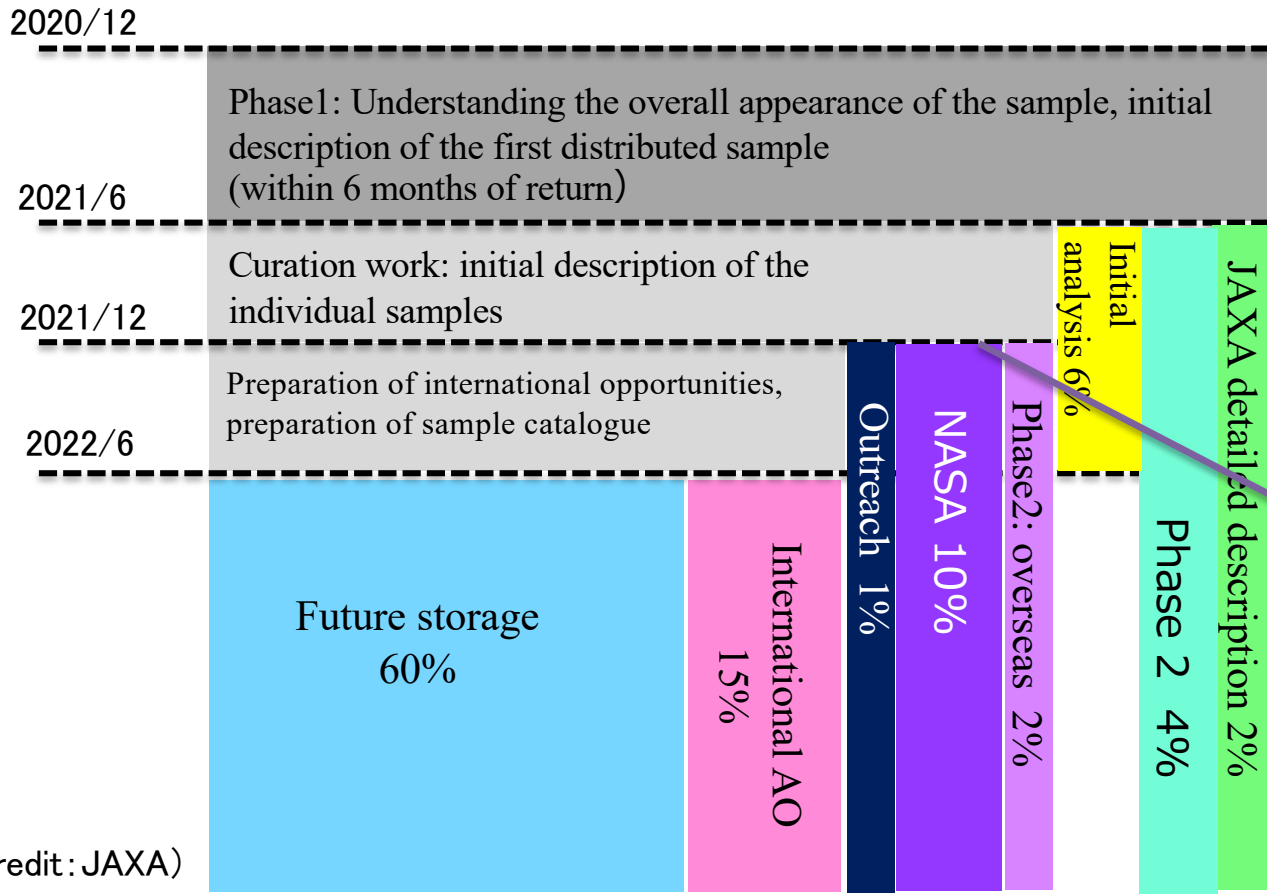
*All distribution is by weight %



1. Curation activity status and future plans



Based on the agreement between NASA and JAXA, 10% of the Ryugu sample has been distributed to NASA.



Total sample : ~5.4 g

- Chamber A : 3.2 g
- Chamber B : <0.1 g
- Chamber C : 2.0 g
- Other : ~0.2 g

Sample distribution to NASA

- 0.5 g
- * Approx. 0.25g from each of chambers A & C.
- * Includes particle/powder sample

*All distribution is by weight %

(credit : JAXA)



1. Curation activity status and future plans



The NASA-JAXA inter-institutional agreement :

- 1) Distribute 10% (weight ratio) of the recovered sample one year after returning.
- 2) The distributed sample should be “**representativeness**” of the recovered sample.
- 3) The distributed sample must be “**unprocessed**” (preserved in original state).

Examples of representativeness

- Particle/power ratio (~2:3)
- Taken from both chambers A & C



Microscope image of the recovered sample (left: chamber A, right: chamber C). Container diameter: 21 mm.

Examples of unprocessed

- No contact with atmosphere.
- No damage to the sample during examination (X-rays, UV or electron beams have not been used).
- No pollution from the environment during examination (contamination control).
- Used only approved procedures / equipment during examination.



1. Curation activity status and future plans



11/30 CST: completed transfer from JAXA to the NASA Johnson Space Center.



In the NASA clean room, NASA & JAXA members performed (left) removal of the sample from the sample container and (right) confirmation of the contents.



1. Curation activity status and future plans



On 11/30 CST, a confirmation ceremony for the sample delivery was held at the NASA Johnson Space Center.



Group photo of NASA/JAXA members who participated in the delivery ceremony



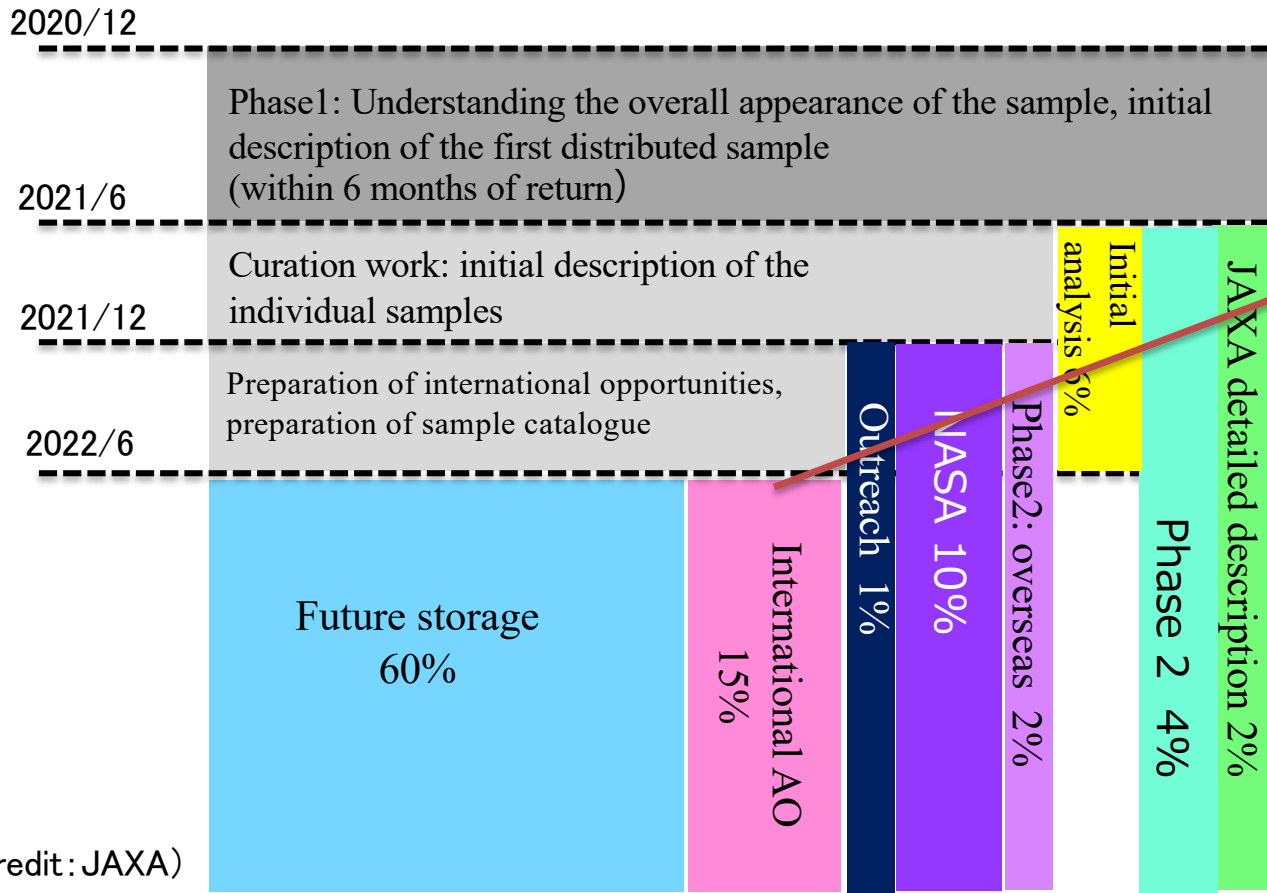
Signatures of the NASA and JAXA curators.



1. Curation activity status and future plans



Based on the agreement between NASA and JAXA, 10% of the Ryugu sample has been distributed to NASA.



- International call for research proposals
- Research proposals will be evaluated by a panel selected from experts in Japan and abroad.
- Proposals and distribution of samples will be determined based on this evaluation.
- Distribution will begin after approval by the Hayabusa2 Sample Allocation Committee.

*All distribution is by weight %

(credit: JAXA)



1. Curation activity status and future plans



The sample catalogue will be open to the public from mid-January (scheduled), in preparation for the international open call in summer 2022.

The screenshot shows the Hayabusa2 Sample Library interface. The header includes navigation links for 'About', 'Usage', and 'Request Sample', along with logos for ASRG, DARTS, and JAXA. The main content area displays search results for 'Search results' with a total of 266 items and 243 hits. The search constraints are: name: (none), room: RA & RB & RC, form: (none), label: (none), category: (none), phase: (none), size: (none), weight: (none). The results table has columns for 'closeup photo', 'name', 'form', 'weight(mg)', 'size(μm)', 'FTIR', 'photo', and 'link/download'. Three results are visible: A0001, A0002, and A0003, all categorized as 'particle'. Each result includes a closeup photo, a photo of the sample in a container, and links to 'all description', 'data folder', and 'FTIR(csv)'. The left sidebar contains options for 'Display style' (table, tree, thumbnail), 'image size' (small, medium), 'Item per page' (25, 50, 100), 'Hidden columns' (allocation status, condition, category, phase, label, MicrOmega Wavelength, MicrOmega, BSE, EDS), and 'Search constraints' (name, room, label, form).

Image of sample catalogue



1. Curation activity status and future plans

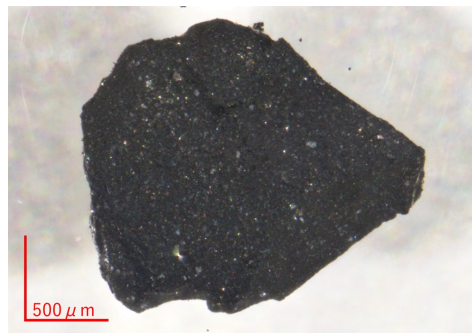


Samples released for public viewing in December 2021

Loaned to the National Museum of Emerging Science and Innovation



A0116:
Chamber A sample (1st TD)
Major axis 2.2mm
Weight 2mg



C0124:
Chamber C sample (2nd TD)
Major axis 2.1mm
Weight 2mg

Loaned to the Sagamiara City Museum



A0161:
Chamber A sample (1st TD)
Major axis 2.2mm
Weight 2mg



C0149:
Chamber C sample (2nd TD)
Major axis 2.1mm
Weight 2mg

For the information on the public release, refer to (3): Ryugu sample public release



2. Spacecraft operation status



- Ongoing Extended Mission operation (operation has continued for one year after returning to the Earth)
- Flight status is shown in the table on the right.
- In scientific observations, observations of the zodiacal light have been carried out six times since returning to the Earth and the data is being analysed. (Another observation is scheduled for today.)

Reference

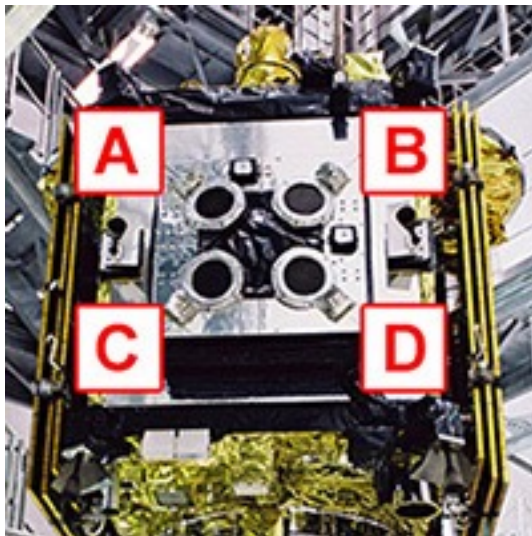
- IAF World Space Award

Spacecraft flight status on 2021/12/06

Item	Value
Days since launch	2560
Total flight distance since launch	~6,246 million km
Earth-spacecraft distance (round trip propagation time)	~100 million km (~668s)
Sun-spacecraft distance	~130 million km (~0.87au)
Velocity relative to Sun	~32.8km/s
Acceleration by ion engines since Earth return	~470m/s



Reference: Ion engine operating status



Since 2021/01, four ion engines have been in operation for a cumulative total of 7138 hours, and are scheduled to operate until the end of December. On October 23, 2021, this surpassed Hayabusa's impulse of 0.9474 MN s (meganewton-second) and this record will be broken every day from now.

Ion engine B is currently operating at near maximum specific impulse to save fuel. 40.5 kg of Xe has been consumed and 25.5 kg remains.

Table: Cumulative results of ion engines A, B, C, and D and comparison with Hayabusa

	A	B	C	D	IES
End of 2020, time operated	6637	11	8051	7453	9423
End of Nov. 2021, time operated	6997	4129	9221	8943	13884
(Hayabusa, time operated	7	12809	11989	14830	25590)
Extended mission, time operated	360	4118	1170	1490	4461
Cumulative impulse, MNs	0.236	0.124	0.308	0.301	0.968
(Hayabusa impulse, MNs	0.0001	0.322	0.264	0.361	0.947)

(credit: JAXA)



3. Ryugu sample public release



- National Museum of Emerging Science and Innovation
 - Sample return capsule, Ryugu sample display
 - 12/4 (Sat.) ~ 13 (Mon.) (Press preview on morning of Dec. 3)
 - <https://www.miraikan.jst.go.jp/en/news/general/202111102216.html>

- Sagami-hara City Museum
 - Ryugu sample exhibit
 - 12/6 (Mon.) ~ 12 (Sun.) Advanced reservation required
 - <https://sagamiharacitymuseum.jp/>



Reference



Future of JAXA's sample return exploration and curation



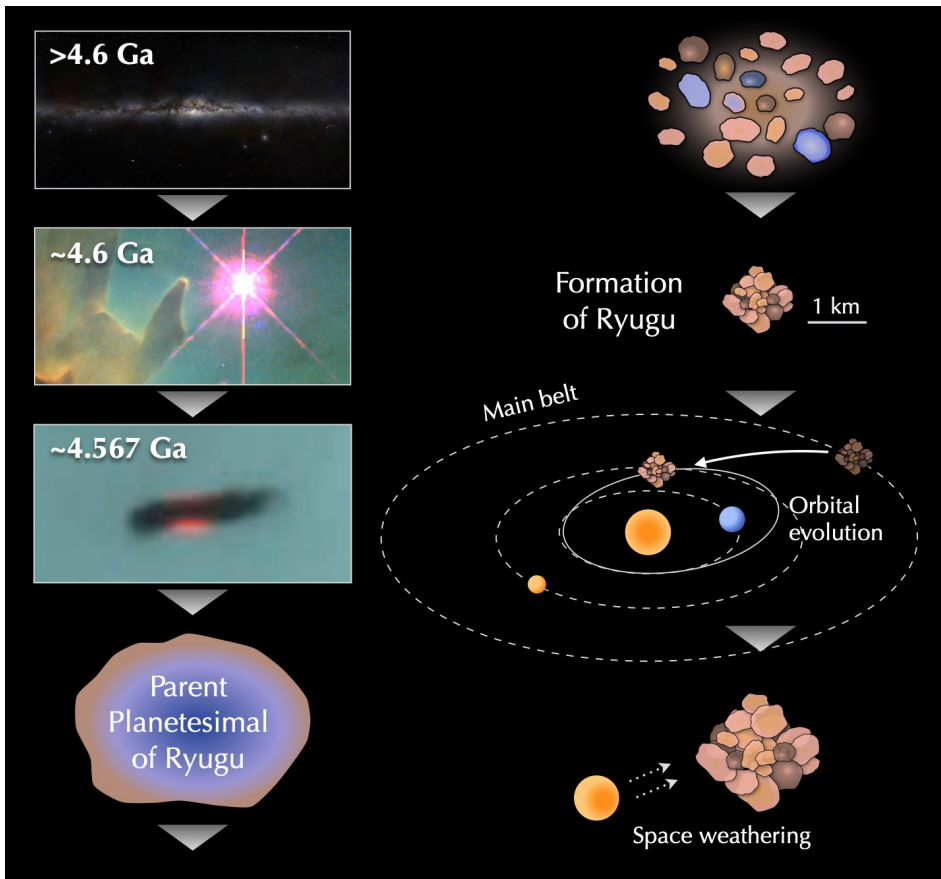
- Based on the experience gained from Hayabusa/Hayabusa2, JAXA has formed a partnership with NASA and other institutes for world leading exploration and curation activities in the 2020s.
- To continue to push the boundaries of sample return exploration, the **Martian Moons eXploration (MMX) mission will be launched in 2024 FY**, with the aim of **returning the first sample from the Martian sphere** during the 2020s.

World first SR from the Martian sphere





Initial analysis summary



- Supervisor Shogo Tachibana (U. Tokyo)
- Chemical analysis team Hisayoshi Yurimoto (Hokkaido U.)
- Stoney material analysis team Tomoki Nakamura (Tohoku U.)
- Sandy material analysis team Takaaki Noguchi (Kyoto U. / Kyushu U.)
- Volatile component analysis team Ryuji Okazaki (Kyushu U.)
- Organic macromolecule analysis team Hikaru Yabuta (Hiroshima U.)
- Soluble organics analysis team Hiroshi Naraoka (Kyushu U.)

109 universities and research institutes in
14 countries, 269 people.

(image credit Shogo Tachibana)



Summary of ion engine operation for the nominal mission



- On September 17, 2020 at 03:15:45 am JST, the ion engines were shutdown as planned, after a total of 22, 348 hours of operation. This completed the round-trip ion engine operation to Ryugu.

Summary of ion engine operation (at 17 Sept. 2020)

	Thruster	Hayabusa2			Hayabusa
		to go	return	round trip	
cumulative operation time, (hour)	A	6450	255	6705	7
	B	11	22	33	12809
	C	5193	2888	8081	11989
	D	6418	1111	7529	14830
	IES	6515	2999	9514	25590
	All	18073	4275	22348	39635
ON/OFF cycle	A	78	4	82	14
	B	3	2	5	429
	C	60	34	94	236
	D	85	15	100	1806
	IES	93	37	130	420
	All	233	52	285	2425
Total Impulse, MNs	A	0.2192	0.0066	0.2258	0.0001
	B	0.0002	0.0007	0.0009	0.3221
	C	0.1753	0.0995	0.2748	0.2639
	D	0.2209	0.0362	0.2571	0.3613
	IES	0.6158	0.1428	0.7586	0.9474
	All	1.0314	0.2851	1.3165	1.5915
Maximum Thrust, mN	A	10.03	9.92	10.03	7.42
	B	7.61	9.90	9.90	8.36
	C	10.08	10.16	10.16	8.30
	D	10.16	10.08	10.16	7.95
	IES	29.66	29.63	29.66	24.12
	All	29.66	29.63	29.66	24.12

Including operation test. IES indicates the total time when one or more ion engines were operated. (Powered flight operation time)

https://www.hayabusa2.jaxa.jp/topics/20200925_IonEngine/



Receiving the IAF World Space Award



- This year (2021) the Hayabusa2 team was awarded the “IAF World Space Award”.
- The award ceremony was held at the opening of the 72nd International Astronautical Congress (IAC) on October 25 in Dubai.



At the award ceremony. Project Manager Tsuda (right) and JAXA President Yamakawa (second from right)



Project Manager Tsuda giving a speech at the award ceremony.



The award certificate and medal.