Asteroid explorer, Hayabusa2, reporter briefing

November 12, 2019

JAXA Hayabusa2 Project

Topics

Regarding Hayabusa2,

- Departing Ryugu

Contents

0. Hayabusa2 and mission flow outline
1. Current status and overall schedule of the project
2. Details regarding the departure from Ryugu
3. Outreach for Ryugu
4. Future plans

Note:
In the material distributed during the reporter briefing, the time for departure from Ryugu was written as 10:00. However, we have modified the time to 10:05 in this copy, as this is the final time decided.

Overview of Hayabusa2

Objective

We will explore and sample the C-type asteroid Ryugu, which is a more primitive type than the S-type asteroid Itokawa that Hayabusa explored, and elucidate interactions between minerals, water, and organic matter in the primitive solar system. By doing so, we will learn about the origin and evolution of Earth, the oceans, and life, and maintain and develop the technologies for deep-space return exploration (as demonstrated with Hayabusa), a field in which Japan leads the world.

Expected results and effects

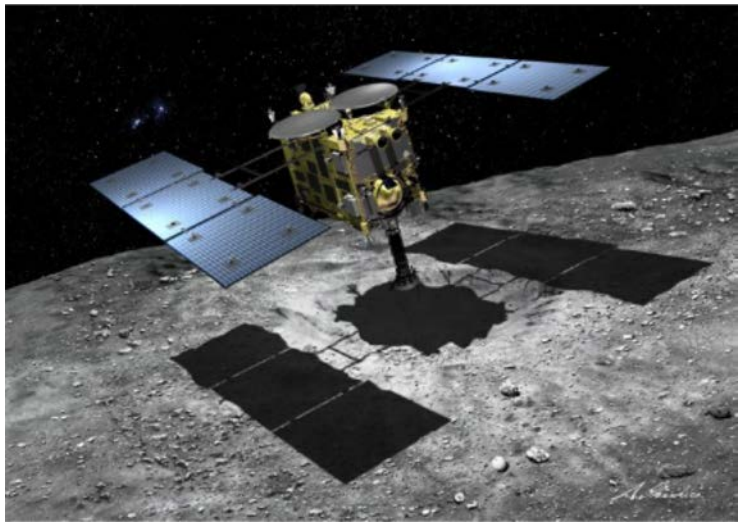
- By exploring a C-type asteroid, which is rich in water and organic materials, we will clarify interactions between the building blocks of Earth and the evolution of its oceans and life, thereby developing solar system science.
- Japan will further its worldwide lead in this field by taking on the new challenge of obtaining samples from a crater produced by an impacting device.
- We will establish stable technologies for return exploration of solar-system bodies.

Features:

- World's first sample return mission to a C-type asteroid.
- World's first attempt at a rendezvous with an asteroid and performance of observation before and after projectile impact from an impactor.
- Comparison with results from Hayabusa will allow deeper understanding of the distribution, origins, and evolution of materials in the solar system.

International positioning:

- Japan is a leader in the field of primitive body exploration, and visiting a type-C asteroid marks a new accomplishment.
- This mission builds on the originality and successes of the Hayabusa mission. In addition to developing planetary science and solar system exploration technologies in Japan, this mission develops new frontiers in exploration of primitive heavenly bodies.
- NASA too is conducting an asteroid sample return mission, OSIRIS-REx (launch: 2016; asteroid arrival: 2018; Earth return: 2023). We will exchange samples and otherwise promote scientific exchange, and expect further scientific findings through comparison and investigation of the results from both missions.



(Illustration: Akihiro Ikeshita)

Hayabusa 2 primary specifications

Mass	Approx. 609 kg
Launch	3 Dec 2014
Mission	Asteroid return
Arrival	27 June 2018
Earth return	2020
Stay at asteroid	Approx. 18 months
Target body	Near-Earth asteroid Ryugu

Primary instruments

Sampling mechanism, re-entry capsule, optical cameras, laser range-finder, scientific observation equipment (near-infrared, thermal infrared), impactor, miniature rovers.

(image credit: illustrations including spacecraft by Akihiro Ikeshita, others by JAXA)

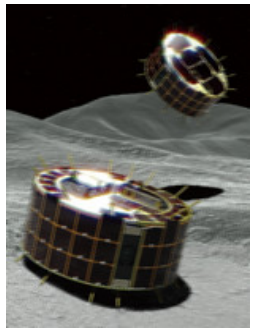
Mission flow

Launch
Dec 3, 2014

Earth swing-by
Dec 3, 2015

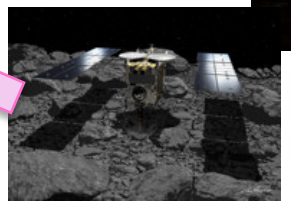
Ryugu arrival
June 27, 2018

MINERVA-II-1 separation
Sep 21, 2018

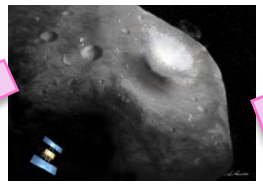


MASCOT separation
Oct 3, 2018

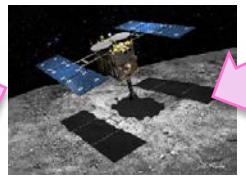
1st touchdown
Feb 22, 2019



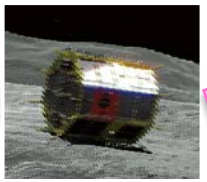
Impactor (SCI)
5 April, 2019



2nd touchdown
July 11, 2019

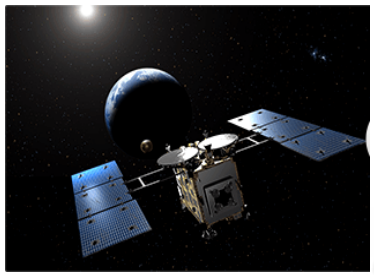


MINERVA-II-2 separation
Oct 3, 2019



Ryugu departure
Scheduled: Nov 13, 2019
completed →

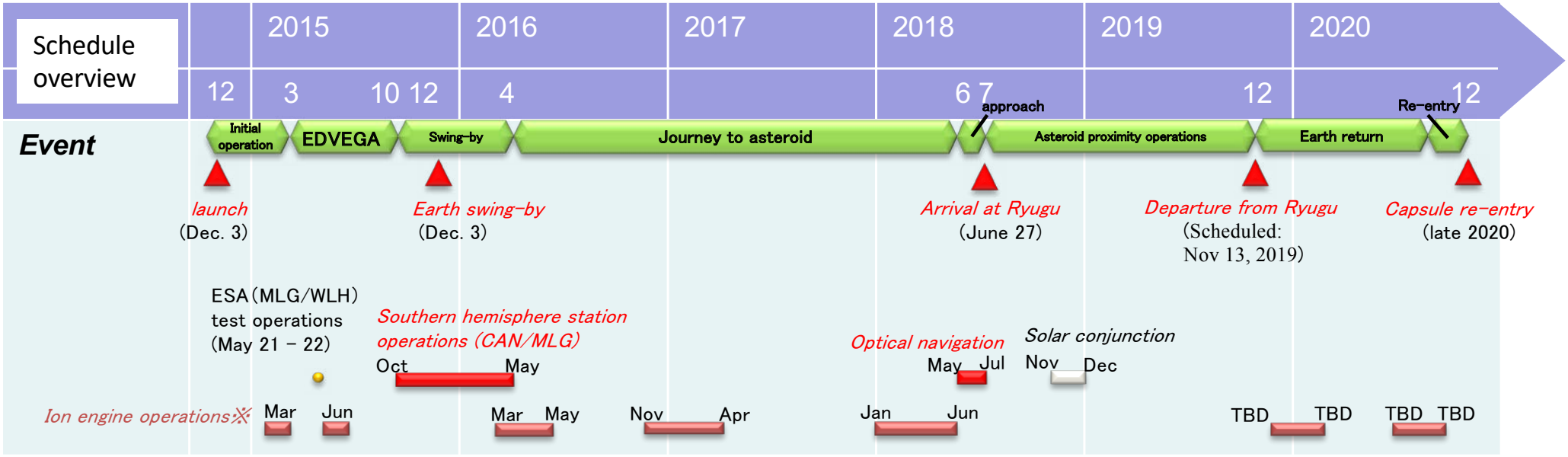
Earth return
End of 2020



1. Current project status & schedule overview

Current status:

- BOX-C operation was conducted from October 19 and completed as scheduled on October 30.
- Final confirmation and preparations are underway for departure from Ryugu.
- The scientific meeting “Asteroid Science in the Age of Hayabusa2 and OSIRIS-REx” was held in Tuscon, USA and with many members of the Hayabusa2 project participating.



2. Departure from Ryugu

- Ryugu departure：November, 13 at 10:05 JST（planned）
  At this time, the “Near Asteroid Operation Phase” will shift to the “Return Phase”.

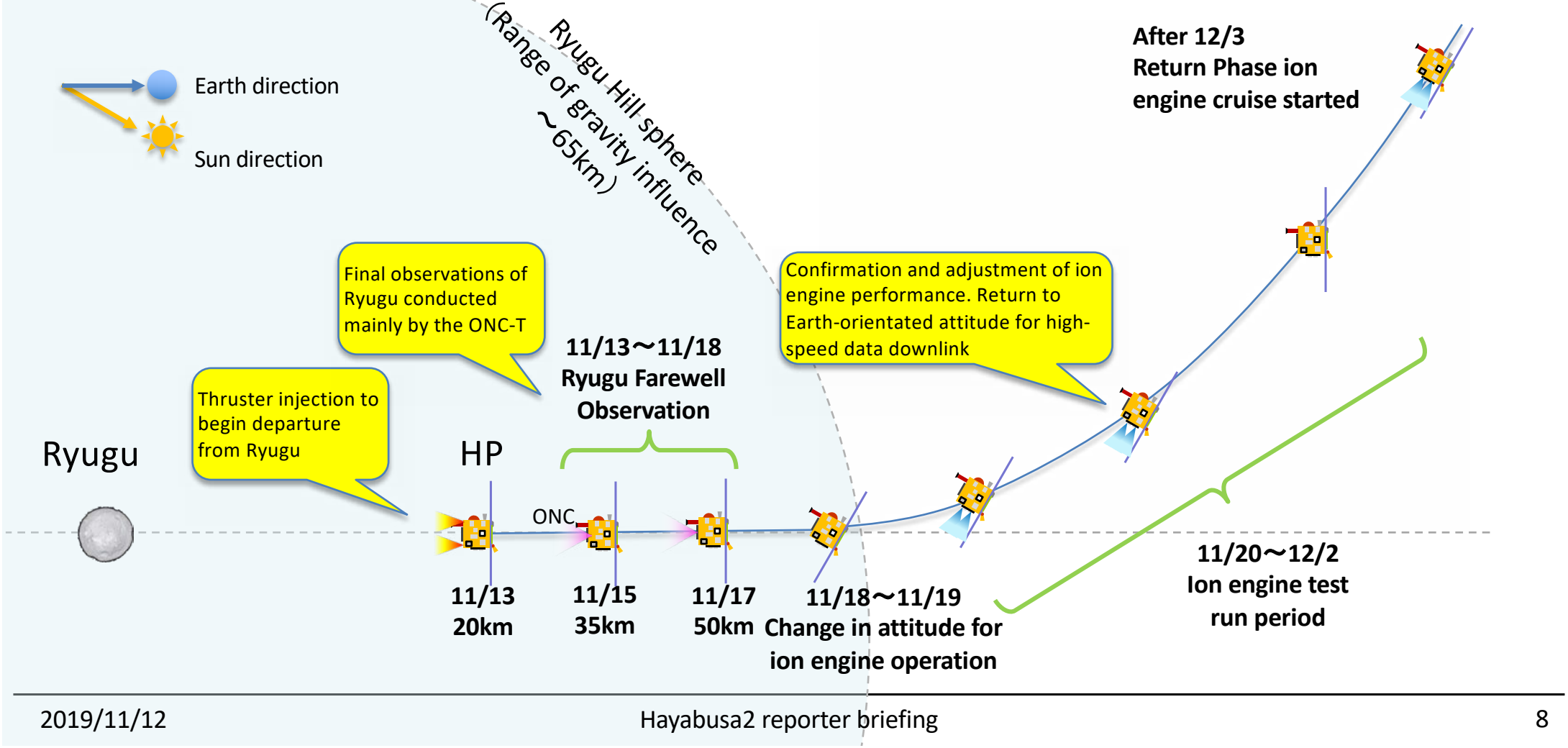
- The prerequisites for departure, namely (1) that there are no problems with the scientific results and (2) preparations for departure are complete were confirmed by the project.

- From the home position, the spacecraft will start to move away from the asteroid at a speed of about 10 cm/s using the RCS thrusters.

- Images of Ryugu moving away will be captured for about 5 days (“Ryugu Farewell Observation”). After that, Ryugu will not be visible due to a change in spacecraft attitude.

- After a trial run for the ion engines from November 19 ～ December 2, the ion engine cruise operation will begin after December 3.

2. Departure from Ryugu



Hayabusa2 Mission Success Criteria

Mission goal	Minimum success	Full success	Extra success
【Science goal 1】 Investigate the material science characteristics of C-type asteroids. In particular, clarify the interaction between minerals, water and organic matter.	Provide new insights on the surface material of C-type asteroids by observations in the vicinity of the asteroid.	Obtain new findings on mineral-water-organic interactions from the initial analysis of the collected samples.	Integrate astronomical & microscale information to create new scientific results regarding materials for Earth, sea and life.
【Science goal 2】 Investigate the formation process of asteroids by direct exploration of the asteroid's reaccumulation process, internal structure and subsurface material.	Provide insights on the internal structure of the asteroid by observations in the vicinity of the asteroid.	Obtain new knowledge on the internal structure and subsurface material of the asteroid by observing the phenomena caused by collisions with an impacting body.	・Present scientific results on asteroid formation based on new findings regarding the collision destruction & reaccumulation process. ・New scientific results from the exploration robots on the surface environment of asteroids.
【Engineering goal 1】 Improve robustness, accuracy and operability of the new technology implemented in Hayabusa, and mature it as a technology.	Rendezvous with a target orbit using ion engines for deep space propulsion.	・Drop the exploration robot to the asteroid surface. ・Take a sample of the asteroid surface. ・Collect the re-entry capsule on Earth.	N/A
【Engineering goal 2】 Demonstrate impact object colliding with a celestial body.	Construct a system to allow an impact device to collide with the target object and perform that collision with the asteroid.	Make the impact device collide in a specified area.	Collect a sample of asteroid subsurface material exposed during the collision.

Achieved

Awaiting achievement confirmation

- The red frame marks the goals achieved by the operation up to asteroid departure
- For the spacecraft operation (apart from future academic achievements), all achievements that should be achieved during the near-asteroid phase have been completed

Science observations during nearby operation summary

(Project Scientist Seiichiro Watanabe)

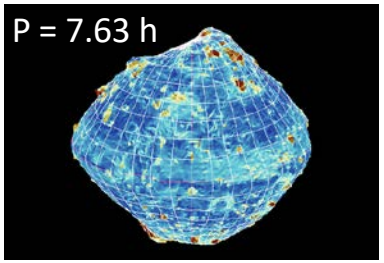
- 2018/7, 8：Initial observations（Box-A, C；medium altitude；gravity measurement, sub-Earth observations）, global observations of Ryugu, comprehension of the overall structure, landing point selection work.
- 2018/8－2019/9：Box-B observation（total of 7 observations of the south pole, north pole, morning / evening side)
- 2018/10－2019/10：Box-C observation（6 descents to ～5 km altitude, in addition to the initial observation）
- All observations use the ONC-T,TIR,NIRS3,LIDAR,
- Low altitude observations also made for touchdowns, rehearsals, rover / lander separation operations etc.
- 2019/2/22：1st touchdown (secured sample expected from CAM-H observations)
- 2019/3/8：Observed descent to S01 area (natural crater, initial candidate area for TD2)
- 2019/4/4：Artificial crater generation with the SCI, successful continuous imaging of impact ejecta by DCAM3.
- 2019/4/25：Successful SCI rater identification observation (specific comparison with 3/21 observation)
- 2019/7/11： 2nd touchdown about 20m from SCI crater (high probability of collection of subsurface material evacuated from crater)

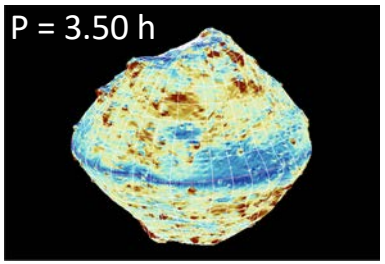
Science observations during nearby operation

(Project Scientist Seiichiro Watanabe)

- 3 papers (+ cover) published in Science Magazine 4/19, and 1 MASCOT paper on 8/23
- Papers in international journals; Nature Astron., Astrophys. J., Icarus, Astron. & Astrophys.

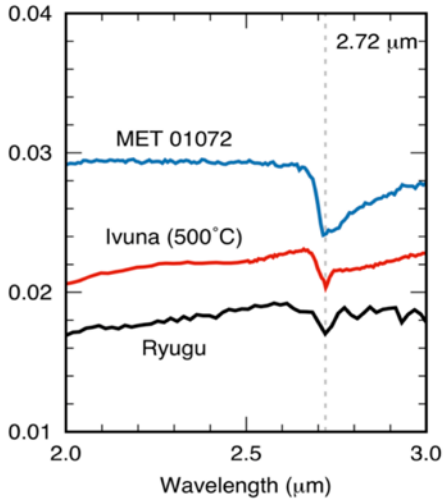
Top-shape generated by past high-speed rotation Watanabe+ 2019

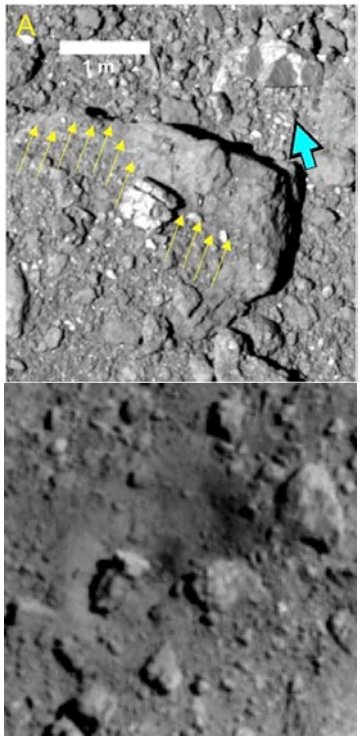




Constraining the parent body, Sugita+ 2019 →

Confirm the presence of water in minerals, Kitazato+ 2019





semi-circular SCI crater (JAXA/U. Tokyo etc)→

3. Ryugu departure outreach

“Good-bye Ryugu” Campaign（Sayonara Ryugu）

Content：Call for messages about Ryugu and Hayabusa2

Period：Nov 12～Nov 18（from Ryugu departure announcement until Ryugu disappears from sight)

How to submit a message：

- On twitter: hashtag #SAYONARA_Ryugu
- To the project or letter (note below-right)
- Messages may be shared

※ The point where Ryugu will no longer be visible will be posted on the Hayabusa2 website

Why, Haya2?

Content：Accept questions via twitter which Project members will respond to in real time.

Date & time：Nov 16（Sat）、15:00～16:30 JST

How to ask：

- Tweet your question during the above time with the hashtag #haya2_QA.
- Anyone can ask any question!（elementary school students or younger, please ask your parents for help)

（Note）Address：
Hayabusa2 Project, 3-1-1 Yoshinodai, Chuo-ku, Sagamihara City, Kanagawa, 252-2510 , Japan

4. Future plans

■Operation schedule

November 13 at 10:05 JST（planned） Ryugu departure

November 18～19 move to ion engine attitude

■ Press briefings

December 19 (afternoon) Press briefing @ Tokyo office