

The Science of Sample Return Missions Hayabusa and Hayabusa2

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Hayabusa and Hayabusa2 are both asteroid sample return missions of Japan. Hayabusa, which was launched in 2003, explored an S-type asteroid (25143) Itokawa in 2005, and came back to the earth with its sample in 2010. Hayabusa2, the follow-on mission of Hayabusa, was launched on December 3, 2014. The target of Hayabusa2 is Asteroid (162173) 1999 JU3, which is a C-type asteroid.

Hayabusa had four science instruments: AMICA (optical CCD camera), LIDAR (laser altimeter), NIRS (near infrared spectrometer), and XRS (X ray fluorescence spectrometer). The initial scientific results by the data of these instruments and by the analyses of returned samples were published in issues of Science in 2006 and 2011. The samples of Itokawa were distributed to scientists worldwide by International AO (Announcement of Opportunity) in 2012 and 2013. And the third AO is under consideration now (February 2015). The curation of the Itokawa samples are still ongoing in JAXA.

As for Hayabusa2, the spacecraft was modified a lot from original Hayabusa, because we had a lot of experiences in Hayabusa mission. The science instruments of Hayabusa2 are as follows: Optical Navigation Cameras (ONC-T/W1/W2), Near Infrared Spectrometer (NIRS3), Thermal Infrared Imager (TIR), Laser Altimeter (LIDAR), Sampling System (SMP), Small Carry-on Impactor (SCI), Deployable camera (DCAM3). Hayabusa2 has three small rovers (MINERVA-II-1A/1B/2) and one lander (MASCOT). Hayabusa had only one small rover MINERVA, but the landing of MINERVA on the surface of Itokawa was unsuccessful. MASCOT was developed by DLR and CNES. Some of the science instruments of Hayabusa2 are similar to those of Hayabusa, but many of them were modified, because the type of the target asteroid was changed from S-type to C-type.

In this paper, we discuss the scientific aims and expected outcome of Hayabusa2 on the basis of the actual results of Hayabusa. Although the scientific results of Hayabusa2 will be produced in 2018 and 2019 when Hayabusa2 arrives at 1999 JU3 and after 2020 when the samples are returned to the earth, it is very important to discuss about the science of Hayabusa2 beforehand in order to maximize it.