Sample return from asteroids — Hayabusa2 and the next

M. Yoshikawa[1], H. Kuninaka[1], N. Inaba[1], Y. Tsuda[1], S. Watanabe[2], O. Mori[1], H. Yano[1], R. Nakamura[3], and J. Kawaguchi[1]

[1]Japan Aerospace Exploration Agency
[2]Nagoya University
[3]The National Institute of Advanced Industrial Science and Technology

In 2006, a few years before the Earth return of Hayabusa, which is the first asteroid sample-return mission in the world, we started to consider the next asteroid sample-return mission, Hayabusa2. Hayabusa was a mission for engineering, but Hayabusa2 focuses also on the science. The scientific purpose of Hayabusa2 is to learn about the origin and evolution of the solar system, especially, the origin of water and organic matters. It is considered that C-type asteroids contain more organic matters and hydrated minerals than S-type asteroids like Itokawa. Therefore, the C-type asteroid (162173) 1999 JU_3 was selected as the target. From the technological point of view, the purpose of Hayabusa2 is to make a more reliable and robust system for sample-return exploration. The scale of the spacecraft is similar to Hayabusa, but many parts are modified so that we will not have to face the trouble that we experienced in Hayabusa. We will try new things, too. One of them is the impactor, which creates a small crater on the surface of the asteroid. Then, we can sample the sub-surface material as shown in the figure. We are now preparing the spacecraft for launch at the end of 2014. Hayabusa2 will arrive at the asteroid in June 2018. It will stay there for about one and half years. Then, it will leave the asteroid in December 2019, and will come back to the Earth in December 2020 [1].

We have already started to consider the next sample-return mission after Hayabusa2. In this future mission, the target asteroid is a Jupiter Trojan, which is a more primitive asteroid (D/P-type asteroid) than the S-type Itokawa and C-type 1999 JU_3. We use the solar-power-sail technique, which was demonstrated successfully by IKAROS. IKAROS means Interplanetary Kite-craft Accelerated by Radiation Of the Sun, and it was the first interplanetary solar sail in the world. The science purpose of this Jupiter Trojan mission is to study the various kinds of issues related to the planetary formation, such as the planetary migration and the material evolution beyond the snow line. We are investigating the possibility of the sample return from a Trojan asteroid, although the sample return from a Trojan is quite difficult and considered to be at the level of extra-success.

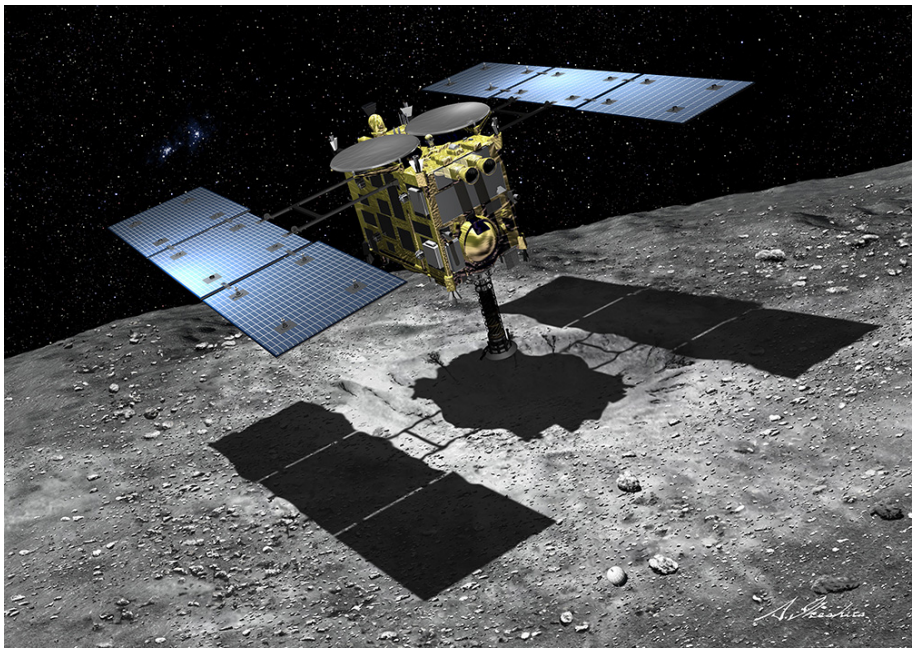

Figure: Hayabusa2 is touching down in or near the crater created by the impactor.

References: [1] M. Yoshikawa, S. Watanabe, Y. Tsuda, H. Kuninaka (2014). Hayabusa2 - The Next Asteroid Sample Return Mission of Japan. The 29 ISTS Special Issue of Transaction of JSASS, Aerospace Technology Japan, in press.