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Scientific significance of sample return from Martian moons
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The asteroid explorer Hayabusa2 began a six-year round trip in December 2014 to return surface samples of a near-Earth carbonaceous-type asteroid 1999 JU_3 following Hayabusa's successful return of the first asteroid samples to Earth. Hayabusa2 will arrive at 1999 JU_3 in mid-2018, and fully investigate and sample the asteroid at three locations during its 18-month stay. The samples from 1999 JU3 will be delivered to the Earth in December 2020. Primitive small bodies are the evolved remnants of planetesimals that were the building blocks of planets, and detailed on-site observation by a spacecraft and analyses of return samples will provide direct evidence of planetesimal formation and dynamical and chemical evolution of the solar system. Moreover, such small bodies could have delivered volatile components to rocky planets in the early solar system.

Sample return missions to primitive small bodies such as main belt asteroids, Jovian Trojan asteroids, icy satellites, and comets require a timescale of decades, and it is important to plan short-term exploration missions to primitive bodies. Here we propose a sample return mission to Martian moons (Phobos and Deimos), of which characteristics resemble those of C-type or D-type asteroids. If they are captured main-belt asteroids, their surfaces have not been heated as much as near-Earth asteroids are. Martian moons are thus likely to preserve more primitive materials such as ice, which is one of possible constituents responsible for their low bulk-densities. If they are remnants of building blocks of Mars, the returned samples will provide us the first and direct information on the formation of Mars, the bulk chemistry of Mars, and the isotopic compositions of volatile elements as a starting point of Martian environmental evolution. Isotopic compositions of returned samples will be a key to address this issue on the origin of Martian moons. Surface regolith of Martian moons may contain ejecta from the Martian surface and/or the escaped Martian atmosphere, and the returned samples may enable us to put constraints on the crustal and environmental evolution of Mars. The remote-sensing observation of Martian atmosphere and surface from the spacecraft can also be done from the spacecraft. In this presentation, we will describe the outline and scientific rationales of the sample return mission from Martian moons.

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