

Simultaneous Public Exhibition of Itokawa and Ryugu samples

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1. Particles returned from asteroids Itokawa and Ryugu and their exhibitions

The Hayabusa spacecraft first returned a sample (~1 mg) from S-type near-Earth asteroid (25143) Itokawa on June 13, 2010 after a series of troubles during the mission. The safe delivery of the re-entry capsule, as compensation for the spacecraft being burned up and vanished in the atmosphere, drew significant attention from the public. The excitement led to the creation of four films, including one specifically made for planetariums. The returned sample, which is very similar to equilibrated ordinary chondrites, the most common meteorites on Earth [e.g., 1–4], underwent thermal metamorphism on the Itokawa's parent planetesimal and recent geological processes on the surface of current Itokawa [e.g., 5–7].

The first public exhibition of Itokawa particles was held in 2013 at the Sagamihara City Museum and the National Museum of Nature and Science and attracted many visitors. However, due to the limited amount of the returned sample and the very small size of the particles, the opportunities of public exhibition of Itokawa particles had been limited. In 2019, nine years after the sample return, JAXA called for applications for a touring exhibition of an Itokawa particle along with the reentry capsule to showcase Hayabusa's engineering and scientific achievements to a broader audience. More than 15 museums responded to the call and the sample was exhibited at various locations throughout Japan.

On December 6, 2020, Hayabusa2 safely delivered samples collected from two surface locations of C-type near-Earth asteroid (162173) Ryugu [8]. The mass of the returned sample exceeded 5 grams [9], more than the mission requirement of 0.1 grams [10, 11], with the largest sample being about 1 cm in size. The returned sample resembles CI chondrites, one of the rarest types of meteorites, and has a chemical composition very similar to that of the Sun [e.g., 12–15]. Ryugu samples contain water in the form of hydrated silicates and a variety of organic matter [e.g., 16, 17]. Their carbon and noble gas contents are among the highest in chondritic meteorites [e.g., 12, 17, 18]. The Ryugu sample records its long history from the very beginning to the current surface geological processes such as space weathering [e.g., 19].

A touring public exhibition of a Ryugu particle was held at 12 museums throughout Japan in the spring of 2022, attracting many visitors as in the exhibition of Itokawa particles.

2. Simultaneous exhibition of Itokawa and Ryugu samples to promote asteroid science and exploration

The Itokawa and Ryugu particles have been displayed at the Communication Hall of Space Science and Exploration at the ISAS/JAXA Sagamihara campus. However, there was no simultaneous public exhibition of two asteroid samples at museums. We believe that the simultaneous exhibition of Itokawa and Ryugu samples will attract more visitors than their individual exhibitions because it will provide opportunities for visitors to learn the engineering challenges and achievements of Solar-System exploration missions, the scientific background and rationale of asteroid sample return missions, and the scientific achievements and new mysteries from two different types of asteroid samples through “real” space samples.

The Astromaterials Science Research Group (ASRG), JAXA, therefore, began activities to promote the simultaneous display of Itokawa (RA-QD02-0554, 51.1 μm in size) and Ryugu (C0054, 2.87 mm in size) samples at museums. The first simultaneous exhibition was held at the Akashi Municipal Planetarium, Hyogo (Fig. 1). The ASRG provided the samples places in N_2 -filled sealed containers and digital microscopes, which allowed the planetarium to display the samples in an easy-



Fig. 1. Left: Simultaneous exhibition of Itokawa and Ryugu samples at the Akashi Municipal Planetarium. Right: Special showcase of the Ryugu sample following a public talk (From left in the photo: Shigosengers, Ojima, Tachibana, and Dr. Black Star).

to-view manner without special display equipments. A public talk by Shogo Tachibana, the lead of the Ryugu sample analysis led by the Hayabusa2 mission, and Tomoko Ojima, an ASRG curator, provided an opportunity for the audience to see the Ryugu particle more closely outside the display box, fostering very intensive interaction between the audience, the curator, the scientist, and the planetarium staff.

One of the lessons learned from the exhibition at the Akashi Municipal Planetarium was that museums and planetariums do not always have display cases suitable for showcasing two samples in a timely manner. In order to make it easier for museums and planetariums to exhibit the samples without special preparation, we developed a touring exhibition package that includes two display cases with transportation boxes (Fig. 2), digital microscopes, monitors, display lights, miniature spacecraft models, and 3D-printed asteroids. The package can be sent to museums via regular delivery services, significantly reducing the transportation costs. We also prepared digital data for information panels that demonstrate the two missions and their returned samples, which can be shared with museums during the exhibition tour.



Fig. 2. A display case (left) and its transportation boxes.

The pilot exhibition of the Ryugu and Itokawa samples using the touring exhibition package was held in August 2024 at the Nagoya City Science Museum (Fig. 3), and many visitors enjoyed the exhibition as many as 46,000 visitors enjoyed the exhibition. Based on the success of this exhibition, the touring exhibition at various planetariums throughout Japan was planned as part of the Japan Planetarium Association (JPA)'s project to celebrate the 100-th anniversary of the world's first planetarium projection (<https://100.planetarium.jp/>) [20]. The Nagoya City Science Museum plays a central role in coordinating the touring exhibition along with the ASRG. The first exhibition began at the Chino City Yatsugatake Museum, Nagano in September 2024, and the samples are scheduled to be exhibited at more than 10 planetariums in Japan by the end of the 100-th anniversary celebration project (May 2025). The lessons learned from the JPA's exhibition project will significantly contribute to the ASRG's future outreach activities and returned-sample exhibitions.



Fig. 3. Simultaneous exhibition of an Itokawa particle (left) and a Ryugu particle (middle) at the Nagoya City Science Museum using the touring exhibition package.

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