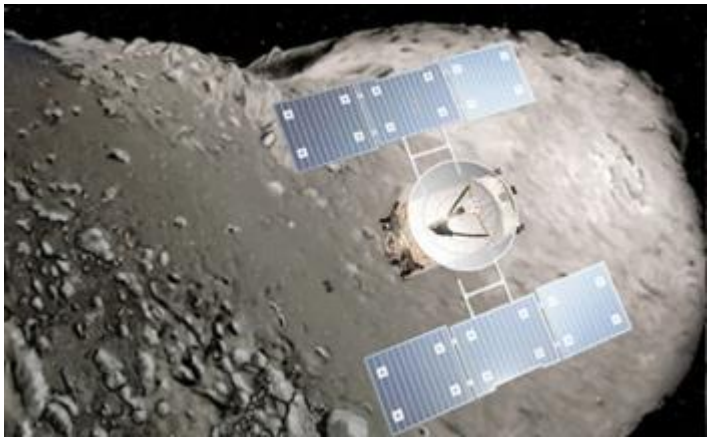
JASCO Micro-Raman analyses Hayabusa asteroid samples



Mineralogy of four Itokawa particles collected by the first Hayabusa mission analysed with JASCO Micro-Raman NRS-3100

Following the successful rendezvous of Japanese spacecraft Hayabusa 2 with the asteroid Ryugu, we take a look back at the Hayabusa 1 mission of 2003 - 2010.

JASCO is proud to have been associated with the analysis of the first ever samples of asteroidal material to be collected from an asteroid and returned to Earth.

MISSION OVERVIEW

Originally codenamed MUSES-C, the ambitious sample return project was formally named HAYABUSA, Japanese for Falcon, and launched by Mu V launch vehicle on 9 May 2003. Using new technology ion engines and a slingshot boost around Earth on 19 May 2004, the spacecraft arrived at an altitude of about 20 km from the Itokawa asteroid on 12 September 2005. After a period of reconnaissance operation, the spacecraft transferred to a holding postion at an altitude of about 7 km from the asteroid's surface. During 8 to 28 October 2005, the spacecraft left this position and made tours to various altitudes and solar phase angles to access the polar regions. A sampling location on a smooth terrain called Muses Sea was selected. The touchdown, the 30-min stay on the asteroid surface, and the liftoff from the surface were performed on 19 and 25 November.

Hayabusa began the long return to Earth in April 2007. The reentry capsule and the spacecraft finally re-entered Earth's atmosphere on 13 June 2010. The heat-shielded capsule made a parachute landing in Woomera in the South Australian outback, while the spacecraft itself broke up and incinerated in a large fireball visible in the Australian night sky.

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RESULTS

According to Japanese scientists, the composition of Hayabusa's samples was more similar to meteorites than known rocks from Earth. Their size was mostly less than 10 micrometers, and the researchers found concentrations of olivine and pyroxene in the samples.

Further study of the samples had to wait until 2011 because researchers were still developing special handling procedures to avoid contaminating the particles during the next phase of research. The Japan Aerospace Exploration Agency (JAXA) announced that 1500 extraterrestrial grains had been recovered, comprising the minerals olivine, pyroxene, plagioclase and iron sulphide. JAXA performed detailed analyses of the samples by splitting particles and examining their crystal structure.

"Science" magazine devoted six articles to findings based on dust collected by Hayabusa. Scientists' analysis of the dust from Itokawa suggested that it had probably originally been part of a larger asteroid. Dust collected from the asteroid surface was believed to have been exposed there for about eight million years, and was found to be "identical to material that makes up meteorites."

JASCO Spectrometry was an important component in the analysis of the samples. Four particles collected during the first touch-down were subjected to intense analysis using optical microscopy, micro-Raman (μ-Raman) spectrometry, scanning electron microscopy (SEM), electron microprobe analysis (EPMA), X-ray absorption spectroscopy (XAS), and transmission electron microscopy (TEM). Raman spectra of potted butts of the four samples (the epoxy-embedded sample remained after ultramicrotomy) were measured with a JASCO μ-Raman spectrometer at Ibaraki University. The spectra identified the mineral content of the samples.

Read the full paper ***Mineralogy of four Itokawa particles collected from the first touchdown site***

Noguchi et al.: Mineralogy of four Itokawa particles collected from the first touchdown site. Earth, Planets and Space 2014 66:124.