What we learnt from Hayabusa mission

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What we have learnt on size, shape and surface structures.
Approach phase
July to August, 2005
Variation of brightness by spin motion
Arrival at Itokawa on 2005.9.12
20km (Gate Position)

Size
535x294x209m (~ 0.5 km)

Spin motion period = 12hrs retrograde
Itokawa is tiny asteroid!!
Itokawa may consist of two-components, i.e. head and body.
Surface structure; large rough area with many boulders (a few m<) and narrow smooth area.

Point A: candidate for sampling site
Meridian of longitude 0° on Itokawa (peculiar black boulder)

(Greenwich on the Earth)
Boundary area between flat region (Muses-Sea) and rough region
Hidden crater (1) and broken boulder (2)
Craters on Itokawa

- very inconspicuous
- concealing by boulders
- buried with fine material
- originally shallow


- 80% of the surface is boulder-rich rough terrain
- The largest boulder, Yoshinodai, is unlikely as large as a boulder from a crater on Itokawa
- Most boulders were formed at the impact disruption of the Itokawa parent body

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**Boulders on rough terrain**

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Answer on spectral mismatching

- Ordinary chondrite and S-type asteroid
- Space weathering hypothesis

Binzel 2002
Developing space weathering on the asteroid 25143 Itokawa,


NIRS data from HAYABUSA
What we have learnt on mass, internal structure and its origin.
Target marker (inside a circle) and shadow of HAYABUSA
HAYABUSA landed on the surface for about 40 min on November 19, 2005 during the 4th descent phase and the 1st touch-down.

Surface material may be blown up and be captured inside the sample receptacle.
Gravity measurements of asteroid during the descent phase

Time (UT) on November 11 – 12, 2005
Mass of Itokawa

3.58±0.18 x 10^{10} \text{kg}

density: 1.95±0.14 \text{ g/cm}^3

porosity: \sim 40 \%
Itokawa (S) is a very small, high-porous asteroid with a rubble-pile structure.
Rubble piles

Impacts grind up surface material into boulders, soil, breccia

Friction keeps smaller material closer to surface

Largest voids near center of the asteroid

Britt and Consolmagno (2001, Icarus 152, 134)
Monolithic asteroids
Whiteley et al. (2002)

- ~40
- fastest; spin period 78 sec (2000DO₈)
- 97.2 min (1995HM), 107.5 min (2000EB₁₄)

all small asteroids
(a few 10 to a few 100 m)
Iokawa; slow spinning (12hrs) small asteroid with rubble pile structure

Pravec et al. (2000, Icarus 147, 477)
Origin of Itokawa

- Catastrophic disruption of larger parent body
- Aggregation of debris (rubble-pile structure)

Current status of HAYABUSA

• No problem in telemetry （from February, 2006）
• After checking ion engines, it will leave for the Earth in December 2006
• Return in June, 2010
• What sample we can see?