

OBSERVATIONS OF 25143 ITOKAWA BY THE ASTEROID MULTIBAND IMAGING CAMERA (AMICA) OF HAYABUSA: MORPHOLOGY OF BRIGHTER AND DARKER AREAS. S. Sasaki¹, J. Saito², M. Ishiguro^{2#}, N. Hirata³, H. Miyamoto⁴, H. Demura⁵, T. Hashimoto², Y. Higuchi⁶, K. Hiraoka³, C. Honda², T. Honda³, K. Kitazato², T. Kubota², T. Michikami⁷, A. M. Nakamura³, R. Nakamura⁸, T. Nakamura⁹, P. Smith⁶, J. Terazono¹⁰, D. J. Tholen¹¹, A. Yamamoto¹², Y. Yokota², H. Akiyama¹³, B. Dermawan⁹, T. Fuse⁹, C. Shinohara⁶, A. Sogame¹⁴, F. Yoshida⁹, and AMICA Team, ¹Mizusawa Astrogeodynamics Observatory, National Astronomical Observatory of Japan, Iwate 023-0861, Japan (sho@miz.nao.ac.jp) ²Institute of Space and Astronautical Science, JAXA, 3-1-1 Yoshinodai, Sagami-hara, Kanagawa 229-8510, Japan, ³Graduate School of Science and Technology, Kobe University, Kobe 657-8501, Japan, ⁴Department of Geosystem Engineering, University of Tokyo, Tokyo 113-8656, Japan, ⁵School of Computer Science and Engineering, Aizu University, Fukushima 965-8580, JAPAN, ⁶LPL, University of Arizona, Tucson, AZ 85705-6643, USA, ⁷Fukushima National College of Technology, Fukushima 970-8034, Japan, ⁸National Institute of Advanced Industrial Science and Technology, Tsukuba 305-8568, Japan, ⁹Optical and Infrared Astronomy Division, National Astronomical Observatory of Japan, Tokyo 181-8588, Japan, ¹⁰Public Affairs Department, JAXA, Tokyo 100-8260, Japan, ¹¹Institute for Astronomy, University of Hawaii, Honolulu, HI 96822, USA, ¹²Remote Sensing Technology Center of Japan, Roppongi, Tokyo 106-0032, Japan, ¹³Faculty of Engineering and Resource Science, Akita University, Akita 010-8502, Japan, ¹⁴School of Engineering, Tokai University, Kanagawa 259-1292, Japan, [#]Now at School of Earth Environmental Sciences College of Natural Sciences, Seoul National University, Seoul 151-742, Korea

Introduction: HAYABUSA (MUSES-C) is an engineering spacecraft by the Institute of Space and Astronautical Science of Japan Aerospace Exploration Agency (ISAS/JAXA) aiming at sample return from S-type asteroid (25143) Itokawa [1]. Between September and November 2005, HAYABUSA observed Itokawa by Asteroid Multiband Imaging Camera (AMICA). A filter wheel of AMICA has a wide bandpass filter and ECAS-equivalent seven narrowband filters: 380 (ul), 430 (b), 550 (v), 700 (w), 860 (x), 960 (p), and 1010 nm (zs) [2]. AMICA observed the whole surface of Itokawa with the solar phase angle around 10 degree from the Home Position (HP) (7km) with nominal resolution 70cm. Observations from closer distances were also performed with spatial resolution as good as 1cm during touchdown phases [3].

Color/Brightness on Itokawa: In addition to dichotomy of rough and smooth areas [4], another most interesting surface feature of Itokawa is the heterogeneity in both color and brightness [3]. The brightness difference is approximately 10-20% on distant images and as high as 30% on close-up images. Even from the observation from HP, some area (e.g. elevated area to the west of Tsukuba) is 20-30% brighter than nearby darker areas (Fig. 1). This difference is much stronger than that by photometric effects. Brighter areas are usually observed at locally elevated zones and gravitationally steep zones. These zones include rims of facets which would be remnant structures of large impacts. Note that steep slopes are not always bright. For example, steep slopes making up the neck at the other side of Yatsugatake are covered by dark boulder-rich

materials (Fig. 1). AMICA color observations show that brighter areas are bluer in color and darker areas are redder [5].

Stratigraphy of darker/brighter areas: Figure 2 shows the Muses Sea area on Itokawa where detailed feature of Yatsugatake-Shirakami region is involved. Shirakami is one of the distinct bright regions on Itokawa. Here, the brightest area (a) has a very steep slope, which is steeper than a typical angle of repose of granular materials. In fact few numbers of boulders were found here. The elevated zone (b) consists of boulder-covered dark areas (10m-scale patched areas) and boulder-poor bright areas.

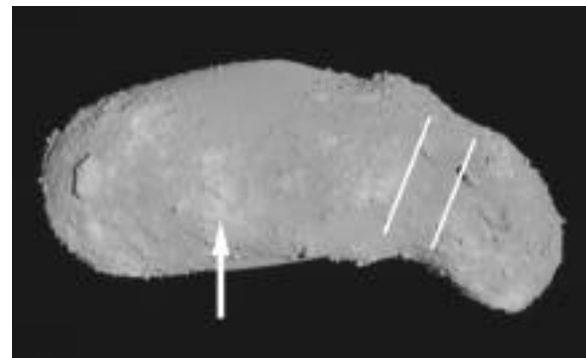


Figure 1 A global image of Itokawa obtained by AMICA. This v-band image show significant brightness difference. Smooth extended areas are usually darker. Bright areas exist usually at local high zones within rough terrain. The arrow indicates one of brighter zones to the west of Tsukuba boulder. The neck zone is denoted by lines. (ST_2421003158).

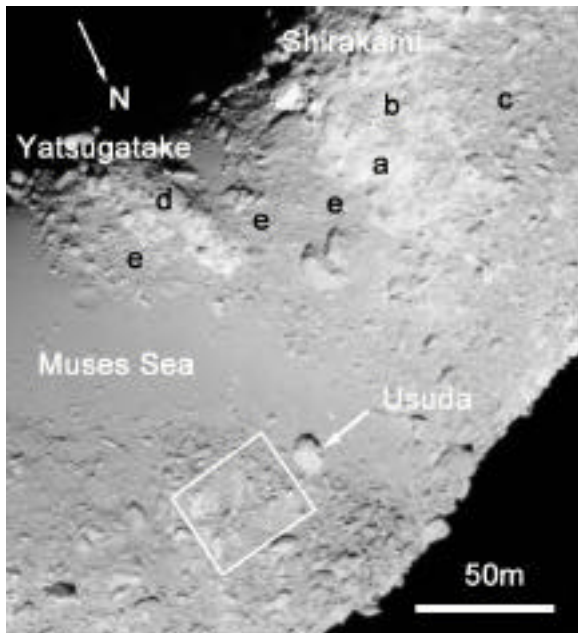


Figure 2 Muses Sea area on Itokawa where detailed feature of Yatsugatake-Shirakami region is involved. The smooth area is Muses Sea, where landing operations of Hayabusa were performed. Yatsugatake is a bright rough ridge to the west of Muses Sea. Shirakami is one of the distinct bright regions on Itokawa. A white rectangle is the area of Fig. 3.. (ST_2474731509)

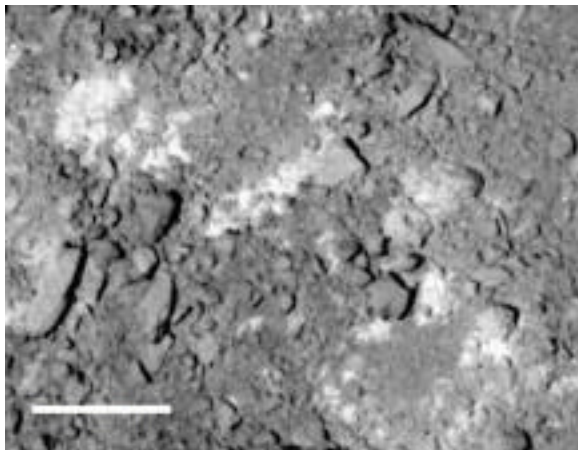


Figure 3 Close-up v-band image of a region to the north of Muses-Sea (just to the east of Usuda boulder). Scale in the figure is 10 m. Dark/bright contrast is enhanced in this figure. (ST_2530292409).

Typical boulder size on the dark patched area is about 1m. On the other hand, the proximal darker area (c) is covered continuously with numerous boulders. Lineations probably of boulder imbrications trends from area (c) to area (b). The morphology here suggests that the bright surface of Shirakami was formed by removal of the superposed dark boulder rich layer. Area (a) is a totally excavated whereas area (b) is partly excavated due to boulder movements. Yatsugatake (d) is a distinct ridge between the MUSES Sea and Shirakami. The top of Yatsugatake is made up of bright area, which might be also explained by excavation of a darker superposed layer. At the foot of Shirakami and Yatsugatake (d) extends a darker and boulder-rich zone (denoted by e). But no distinct flow front or talus structure is recognized, which might imply further complexities. Note that gravitational sliding of regolith materials with different brightness was also observed on Eros [6].

Figure 3 is a close-up image of the area to the north of Muses Sea. Here are observed bright patched surfaces of a few meter scale. Some boulders on brighter surface are dark, which would suggest darker materials should superpose on brighter materials.

In comparison with color observation [4] and experimental data [7,8], we interpret that the darker materials experienced more space weathering than brighter materials. Probably dark weathered boulder-rich surfaces were removed by shaking caused by impacts or planetary encounters, leading to exposure of underlying relatively fresh bright area.

References: [1] Fujiwara A. et al. (2006) (this issue) [2] Nakamura T. et al. (2001) *EPS* 53, 1047-1063. [3] Saito J. et al. (2006) *Science* (submitted). [4] Miyamoto H. et al. (2006) (this issue). [5] Ishiguro M. et al. (2006) (this issue) [6] Thomas, P. C. et al. (2002) *Icarus* 155, 18-37. [7] Sasaki S. et al. (2001) *Nature* 410, 555-557. [8] Hiroi T. and Sasaki S. (2001) *M&PS* 36, 1587-1596.