Initial Characterization of the Muses Sea Smooth Terrain on (25143) Itokawa: the Hayabusa Touch-down Sites

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Sampling from the asteroid surface is the most challenging technical demonstration for the Japanese engineering spacecraft Hayabusa. It is the most important scientific goal of this mission as well. The spacecraft was launched in May 2003 and successfully made a rendezvous with the near Earth asteroid (25143) Itokawa in September 2005. After about 1.5 months of global observation, two sampling site candidates were chosen based upon engineering safety, scientific importance and operational feasibility.

However, after investigating these candidate sites at lower altitudes, the large facet called Little Woomera contain so many large-sized boulders that the spacecraft might not be able to perform a safe descent there. Therefore, all of actual touch-down attempts were conducted above another candidate in the largest smooth terrain called Muses Sea on November 20 and 26, 2005.

In order to maximize scientific promises of laboratory analyses of the returned samples, it is necessary to characterize physical and geological contexts of sampling sites as much as possible by utilizing both on-board science instruments and house-keeping data of the spacecraft. During the first touch-down descent sequence, proximity images with spatial resolution of 6-8mm/pixel and measurements of the fluorescence X-ray spectrometer (XRS) or near-infrared spectrometer were obtained. Additionally, we were able to obtain useful data about geological features, surface condition, regolith grain size, constraints for macroscopic physical properties (coefficient of restitution, coefficient of friction, and stiffness), and equilibrium temperature from house-keeping data.

From the high resolution images, it was found that the vicinity of the first touch-down site was densely filled with size-sorted gravels of the mm-cm order, unlike regolith layers on the asteroid (433) Eros nor the Moon. This view was independently supported by macroscopic physical properties of the surface constrained from dynamics of the sampler horn during the free-fall bounce as well as equilibrium temperature estimated by thermal radiometry of the XRS instrument.