Remote X-ray fluorescence spectrometry of 25143 Itokawa

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The X-ray fluorescence spectrometer, XRS, onboard Hayabusa has observed the surface of the near-Earth asteroid Itokawa for major elemental analysis. We will report the latest results of the XRS observation including the updated elemental ratios Mg/Si and Al/Si for various regions.

The XRS observes the X-ray emission from the asteroid that is excited by irradiation of solar X-rays. Such X-rays includes line spectra characteristic to each element of the surface material. In general, the intensity of line is stronger for more abundant elements, so that this method is applicable to major elemental analysis. Since intensities and spectral profiles of solar X-rays varies time to time, its concurrent monitoring is necessary. The XRS calibrates time by time the X-ray fluorescence excited by the Sun by using a standard sample, which allows quantitative elemental analysis.

Hayabusa was launched on 9 May 2003, and arrived at proximity of the asteroid 25143 Itoakwa on 12 September 2005. The position is called GP (gate position, 20 km earthward from the asteroid). Ground based observations show the asteroid has about 500 m x 300 m size, and rotates about 12.1 hours, and is classified as S (IV) taxonomic class. After a couple of weeks observation, Hayabusa moved to HP (home position, 7km earthward from the asteroid). Solar activity is in quiescent condition in 2005 and the observed X-rays has been faint, but the activity sometimes enhanced due to occurrence of subflares. A relatively favorable period for the XRS observation happens on 19 November 2005, when the first touchdown for sample collection was conducted. During the descent, the spacecraft has kept its attitude suitable for the XRS to observe the asteroid as well as calibrate with the standard sample. Total descent sequence spent more than 15 hours so that the asteroid rotated more than once, which enables the observation from all the longitudes of the asteroid surface.

Elemental analysis from several longitudes has been conducted using those data observed with sufficient S/N ratios due to occurrence of subflares, expecially for the three major elements such as Mg, Al, and Si. Mg/Si and Al/Si are the most valuable parameters for rock type classification. The results show that the surface of Itokawa has chondritic composition. Ordinary chondirites are the most likely than any other types. LL- or L-chondrites are more suited for the results but furether detailed analysis is required such as major elemental analysis of Fe and Ca and degree of thermal processes by estimate the abundance of S. We have not constrained so far whether the asteroid has been much processed or still primordial. Possibility of ancient achondrites such as Accapulcoites cannot be ruled out.

We will report updated information on elemental composition and regional variation in more detail.