Compositional analysis of asteroid ITOKAWA by XRS onboard HAYABUSA

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Some of asteroids are thought to be primitive objects that may be pieces of remnants during the planet formation, so they could have preserve evidence of the nature of the materials in early solar system. In-situ observations have an advantage over ground-based ones in respect that there are no atmospheric attenuations for X-rays. One of these instruments for observation is X-Ray Spectrometer. When solar X-rays illuminates asteroid's surface, the surface emits fluorescence X-rays. Analysis of X-ray fluorescence from the surface of asteroids becomes a powerful method for elemental analysis, for the X-ray fluorescence can provide information of elemental composition of asteroid surface.

The possible energy range to be detected by XRS is 0.5-10keV. X-ray charge-coupled device (CCD) is used as an X-Ray photon detector for XRS. It observes the line spectra of Mg (1.254 keV), Al (1.487 keV), Si (1.740 keV), Ca (3.691 keV), Ti (4.510 keV), and Fe (6.399keV) and so on. This instrument includes 4 CCD sensors that have energy resolution high enough to separate line spectra of major elements (160eV at 5.9 keV). The total effective area is 25cmˆ2 (4CCDs) and the field of view is 3.5 x 3.5 degrees. In addition, the XRS has a standard sample plate aboard to concurrently calibrate X-ray fluorescence excited by the Sun. Composition of the standard sample is intermediate between chondrite and basalt.

This main task of XRS is to observe the X-ray fluorescence and elemental composition on an asteroid's surface. Since solar X-ray usually has steeply decreasing spectrum with energy under a quiescent condition, K-alpha spectra of lighter rock-forming elements such as Mg, Al and Si are easiest to observe. Heavier elements such as Ca, Ti, and Fe are detectable only during highly enhanced solar activity when solar X-rays become more intense and harder. Analyzed data of elemental mass ratio of Mg/Si = 0.78+/-0.09 and Al/Si = 0.07+/-0.03, shows that LL- or L-chondrite is most likely rather than H-chondrite and achondrite by Okada et al. (2006). In this study, heavier elements are investigated carefully, and the results will be reported in detail.