Chemical Composition of the Lunar Surface Material Observed by SELENE Gamma-Ray Spectrometer

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Gamma-Ray Spectrometer (GRS) onboard SELENE (KAGUYA) observes lunar gamma rays with a germanium (Ge) detector [1]. With a high energy resolution, and special resolution, the SELENE GRS has succeeded to identify a number of elements constituting the lunar surface, such as O, Mg, Al, Si, Ca, Ti, Fe, K, Th and U in the upper layer down to ~60 g/cm^2.

The observed energy spectra of gamma rays from the global lunar surface with energies from 0.2 to 12 MeV were accumulated for the two different HV conditions from December 14, 2007 to February 17, 2008 (Period 1) and from July 7 to December 8, 2008 (Period 2). In the observation modes for *Period 1* and *Period 2*, the high voltages of 3.1 kV and 2.5 kV were applied to a Ge detector, respectively. This report presents the preliminary results acquired during the *Period 2*.

Gamma rays from several elements (O, Mg, Al, Si, Ca, Ti, Fe, K, Th, and U) have been identified by utilizing the spectral data obtained from the *Period 2*. The energy resolutions for potassium peak at 1461 keV changed approximately from 12 keV to 20 keV due to radiation damage during this period, being still ~10 times higher than those of Lunar Prospector GRS [2] and Chang'E-1 GRS [3].

Among major elements, the remarkable local differences are seen in gamma-ray intensities of Fe in particular. The gamma-ray intensity of Fe is the highest in the northwestern nearside region. The result is consistent with the distribution of the basaltic maria in this area. In addition, the gamma-ray intensity of Fe in the southern farside where the South Pole-Aitken basin is located is higher than that in the northern farside which corresponds to the feldspathic highland.

The gamma ray line from Mg (1369 keV) is interfered with that emitted from Al. This gamma ray is emitted due to the transition of ^{24}Mg, which is produced by a reaction of ^{27}Al(n,alpha)^{24}Na followed by beta-decay. The correction of gamma-ray intensity from Al is thus needed to derive Mg counting rate, because the structural bodies of the satellite and the GRS are constructed with Al alloy. It is also noted that the feldspathic crust is abundant in Al. Here, we broadly estimated the local variation of the gamma-ray intensity of 1369 keV, which is emitted from Mg and Al, without correction of neutron variation and Al interference. The 1369 keV gamma-ray intensity from Mg and Al is the highest in the northwestern nearside, and a moderately high intensity was observed in the southern farside. The gamma-ray intensity of Fe shows a similar variation to those of Mg and Al. Interestingly, the 1369 keV gamma-ray intensity for Mg and Al of the northern farside is higher in the eastern region than that in the western region. In contrast, the intensity of Fe is higher in the western region than that in the eastern region. The observed anti-correlation of intensities for Mg and Fe implies that the Mg/Fe ratio (or Mg#) may be different between the eastern and western region of the farside highland. It should be reminded that the current result is preliminary, and thus requires further refinement. The global distribution of Mg will be properly determined once corrections are made, considering the difference of the neutron energy spectra in/on the lunar surface, the local variations of the neutron flux, and the interference of Al gamma ray flux from space craft and lunar surface.

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