SELENE X-ray and Gamma-ray Spectrometry and its contribution to lunar science

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The objectives of X-Ray and Gamma-Ray spectrometry onboard the SELENE and its contribution to lunar science are discussed. The SELENE is a scientific lunar polar orbiter at about 100km altitude to conduct a one-year-long observation with 14 missions including X-/Gamma-Ray spectrometry. The key objectives are the characterization and regional variation of lunar rock-types and the understandings of lunar surface structures. The SELENE will provide as high quality and as many kinds of data sets as expected from orbit and greatly contribute to lunar science with combined data analyses between missions.

The X-Ray Spectrometer (XRS) will conduct the first global mapping of major elements with spatial resolution within 20km except for polar region. It has large detection area of 100cm2 and carries array of charge-coupled devices with high energy resolution relative to past missions. It will map major elements (Mg, Al, and Si), essential for rock-type classification and as indicator of evolution processes and other elements (Ca, Ti, Fe) during the higher solar activity.

The Gamma-Ray Spectrometer (GRS) will survey lunar global abundance and regional anomalies of rock component elements and radioactive elements. The GRS carries pure Ge detector with ultra-high energy resolution and will determine many elements in much improved accuracy compared to past missions.

The SELENE realizes great progress in lunar science opened by new technologies. Combined observations of the X/GRS will determine all major elements (Mg, Al, Si, K, Ca, Ti, Fe) and radionuclide (Th, U, K) with spatial resolution of 20km (to 100km dependent on elements) or better and with high accuracy. The GRS will inform on many elements while the XRS will determine major three elements in high accuracy and detailed regional resolution. We summaries expected contribution to solving problems in lunar origin and evolution through X/GRS experiments.

1. Origin of the Moon: Although many ideas have been proposed, giant impact is considered most accountable to analytical results of returned samples of Apollo and Luna as well as consistent with numerical simulations. To examine this, precise bulk composition of the Moon and the understandings of lunar thermal history and inner structure are required. Detailed information is essential on depletion of volatiles, enrichment of refractory elements, depletion of siderofile elements, and Mg#. Lateral and vertical structure of lunar crust is necessary. X/GRS will make a valuable contribution to these problems by surface elemental mapping as well as analyzed crust structures using data from craters or basins as mentioned below.

2. Lunar Highlands: Recent studies show that the highlands, 83%, have heterogeneous composition with hemisphere-scale variation or local anomalies. Highlands predate 4Ga or older and shows clue to genesis evolution and differentiation of pre-mare era. There has been compiled a FeO map with Clementine UVVIS (Jolliff et al, 2000), and other maps will be constructed by the SELENE X/GRS, which assists understanding the formation and evolution of the lunar crust.

3. Lunar Maria: Although origin of mare basalts remains unanswered, the source reservoir formed after floatation of anorthic crust and sink of mantle materials from the magma ocean have formed mare basalts by partial melting. The only 1% of total crust indicates the evolution and differentiation of silicate Moon. X/GRS elemental mapping against the geological variation, chronology, and Ti abundance supplies essential information .

4. Small-scale features: X/GRS are capable of determining major elements of 10km-scale geological features such as each voluminous lava flow, lava domes, dark deposites, small craters with surrounding ejecta, impact melts, and central peaks of craters. These spots have relation to deep materials and are thus considered as important sites to be explored.