

Highlights of SELENE (Kaguya) in Lunar Science

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The SELENE (Kaguya) was launched by the 13th H-IIA launch vehicle on 14 September 2007 and, after its lunar orbit insertion and initial check, is now in its nominal observation phase, orbiting the 100km polar circular orbit. For the Japanese lunar and planetary science community, SELENE is the next opportunity to Hayabusa, a technology demonstration mission to near-earth asteroid Itokawa, but the first total scientific mission in its variety, resolution, and accuracy of instruments.

Main themes in lunar and planetary science are to investigate the origin and evolution of the planet by observation of its surface and interior. Solid materials do not appear to change its form, but does change in geological time scale. Thermal process like igneous activity changes the chemical composition and alters mineralogy in rocks. Movements by cooling process (up- or down-welling of materials) cause tectonic processes by inner stress. Therefore, the current observed conditions in composition, structure, gravity or magnetic anomaly are fossils, or snapshots, of evolution processes. The evolution and its initial conditions could be investigated by the integrated results and considerations with many kinds of observations.

To achieve the purposes, not only the data of SELENE itself but analytical results of lunar rocks and numerical simulations should be combined to interpret the data and investigate the problems in lunar science: 1) how was a large Moon formed with more than 1/100 mass of the Earth, 2) what is lunar interior (composition and thickness of crust, mantle, and core), 3) how is the lunar anorthositic crust formed (via magma ocean?), 4) what causes lunar dichotomy (difference of near and far sides), 5) did the ancient magnetism exist, and 6) what drove the lunar volcanism and tectonics.

SELENE has all the instruments to obtain data to solve these problems. X-ray and gamma-ray spectrometry and visible to near infrared reflectance spectroscopy will map the elemental and mineral composition with most precision ever obtained. Terrain camera of 10m/pixel resolution and laser altimeter will construct most precise global digital elevation model (DEM) and radar sounding will prove the subsurface structures in 5 km depth. Gravity anomaly and moment of inertia will be much improved with using two small satellites (Okina and Ouna) by differential VLBI and four way Doppler measurements to make the first direct determination of the far side gravity field. Magnetic field measurements will map the anomaly of lunar surface magnetism and magnetic response to inform the inner thermal condition. Current activity near the surface will be monitored with alpha-ray measurements.

In this presentation, the highlights in lunar science of early-stage observations by SELENE are presented as well as its expected contribution to lunar and planetary sciences.