FIRST RESULTS OF THE SELENE MULTIBAND IMAGER. M. Ohtake,[1] J. Haruyama,[1] T. Mastunaga,[2] Y. Yokota,[1] T. Morota,[1] C. Honda,[1] M. Torii,[1] Y. Ogawa[2] and LISM Team, [1]Planetary Science Department, Japan Aerospace Exploration Agency (JAXA), 3-1-1 Yoshinodai, Sagamihara, Kanagawa, 229-8510, Japan (ohtake.makiko@jaxa.jp), [2]National Institute for Environmental Studies (NIES), 16-2, Onogawa,Tsukuba, Ibaraki, 305-8506, Japan.

Introduction: The Lunar Imager/SpectroMeter (LISM) is an instrument developed for the SELENE (KAGUYA) mission. SELENE was launched by an H-IIA Launch Vehicle on Septemer 14, 2007, from Tanegashima Space Center. LISM consists of three subsystems, the Terrain Camera (TC), the Multiband Imager (MI), and the Spectral Profiler (SP). The subsystems share some components and electronics including the Data Processing Unit (DPU), Data Processing and Control Unit (DPCU), and Power Control and Distribution Unit (PCDU) [1].

The MI is a high-resolution multiband imaging camera consisting of visible and near-infrared sensors. It acquires push-broom imaging data by using selected lines of area arrays. The spectral band assignments are 415, 750, 900, 950 and 1000 nm for the visible spectrum and 1000, 1050, 1250 and 1550 nm for the near infrared spectrum. The spatial resolution of visible bands is 20 m, and that of near infrared bands is 62 m from the 100 km SELENE orbital altitude. The MI's specifications are listed in Table 1. Pre-flight tests, measurements of MTF, viewing vector, sensor linearity, stray light and electrical noise level and so on indicate that MI will provide sufficient MTF, low noise and low stray light spectral imaging data just as estimated in the MI design phase [2].

We will observe the global mineral distribution of the lunar surface in nine band images acquired by MI.

Objectives of MI: One of the important scientific goals of MI is to investigate small but scientifically very important areas such as crater central peaks and crater walls. Investigations of such small areas will help answer current questions such as the existence, chemical composition, and source of olivine at the central peaks of some craters [3]. The advantage of MI for this aspect is that we can remove topographic effects, which cause false reflectance values seen in the crater wall and crater central peak, by photometric correction with detailed topography. A digital terrain model will be derived from TC stereoscopic images, or MI band sets, that have 11.2 degree maximum parallax.

One of the other important targets of MI is to search for the most primitive lunar crustal materials such as magnesian anorthosites suggested to be located on the lunar far side from recent lunar meteorite studies [4] [5].

First light data of MI: MI successfully took its first lunar images on November 3, 2007, using two orbits during SELENE's check-out period. The orbit of the SELENE main satellite on the day of the LISM-MI first check out already had been set to be nominal, which is polar orbit 100 km in altitude. The Sun elevation angle (incidence angle) of the first light was > 32 degrees. To check LISM-MI hardware functions, all possible observation parameters, such as exposure, compression table and nominal/SP support mode, were

Table 1. Specification of LISM/MI.

	VIS	NIR
Focal length	65 mm	65 mm
F number	3.7	3.7
Field of view	11 deg	11 deg
Spatial resolution	20 m	62 m
Swath width on ground	19.3 km	19.3 km
Detector	2D CCD (1024 x1024 pixel)	2D InGaAs (320 x 240 pixel)
Pixel size	13 x 13 µm	40 x 40 µm
Detector cooler	N/A	N/A
Number of band	5	4
Band assignment	415 +/- 10 nm 750 +/- 5 nm 900 +/- 10 nm 950 +/- 15 nm 1000 +/- 20 nm	1000 +/- 15 nm 1050 +/- 15 nm 1250 +/- 15 nm 1550 +/- 25 nm
Quantization	10 bit	12 bit
S/N	> 100	> 300
MTF	> 0.2 @ Nyquist	> 0.2 @ Nyquist
Integration times	5.33, 2.66 and 1.33 msec	26.4, 13.2 and 6.4 msec
Data compression	DPCM (loss-less)	N/A
Compression rate	< 80%	-
Solar elevation angle in operation	30-90 deg	
Data amount	49.0 Gbit/day	

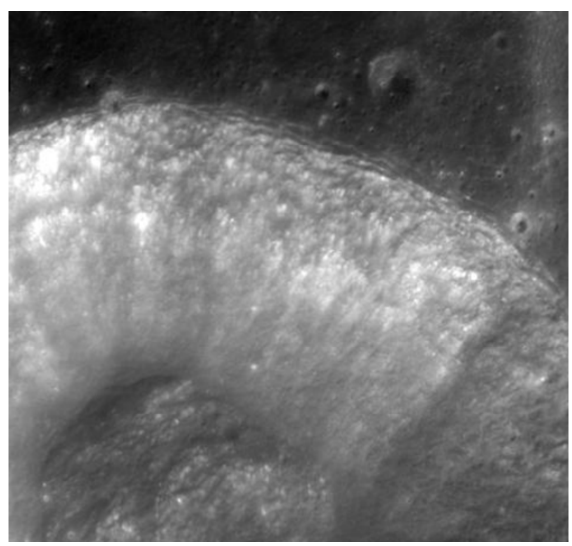

Fig. 1. MI-VIS 750 nm band image (spatial resolution is 20 m/pixel) of a crater (15 km in diameter) located at 44° S, 240 ° E. Small shading features within the wall and apparently slumped and accumulated base material are clearly observed.

used and were confirmed to be normal. During the day one first check out, MI took more than 3500 images (in nine bands) of the lunar surface.

Preliminary evaluation of MI's performance: The above-mentioned first light data confirmed MI's performance to be as follows.

-MTF: As demonstrated in Figs. 1 and 2, we obtained very clear MI images, demonstrating that the MTF of MI is sufficient and had not been changed by launch. It also indicates the advantages of MI's high resolution for understanding detailed features of the crater.

-The dark current and flat field appear to be roughly the same as the pre-flight data, but detailed evaluations using in-flight dark current temperature dependence and flat field coefficient are under way. In Figs. 1 and 2, we adopted primary in-flight dark current temperature dependence and flat field coefficients made by using limited data sets acquired through the check out period.

-Response The MI response had not changed drastically compared to the pre-flight optical test data 1.5 months after the SELENE launch even though we need more precise calibration to estimate the response change quantitatively. No defective pixels have been found in either the VIS and NIR detector. Relative responses between different bands have also been preserved, and the color ratio composite (Fig. 2 b) successfully demonstrates heterogeneous distribution of ejecta near the crater rim.

-No stray light component (either spatial and spectral) has been identified.

Data processing and calibration status: LISM ground data processing systems have been established as a part of SELENE Operation and Analyses Center (SOAC) located in a JAXA Sagamihara Campus.

We are going to produce Level 2B (after radiometric calibration and conversion to radiance), Level 2C (after photometric function normalization, conversion to reflectance and geometric data attachment) and MAP products from MI data and distribute them to the public according to the SELENE open data plan one year after the end of the nominal mission. At this moment, we are making a test version of MI Level 2A, 2B and 2C products and evaluating each calibration procedure.

Observation plan during SELENE nominal mission: The first nominal observation cycle of MI will start on 18 January, in which high latitude region (60 to 90 degrees) will be observed in nominal mode (loss-less compression and nine full bands). MI's nominal observation cycle is then planned in March, April, August, September and October. All data of these six MI cycles will then be combined to provide us images of the whole Moon.

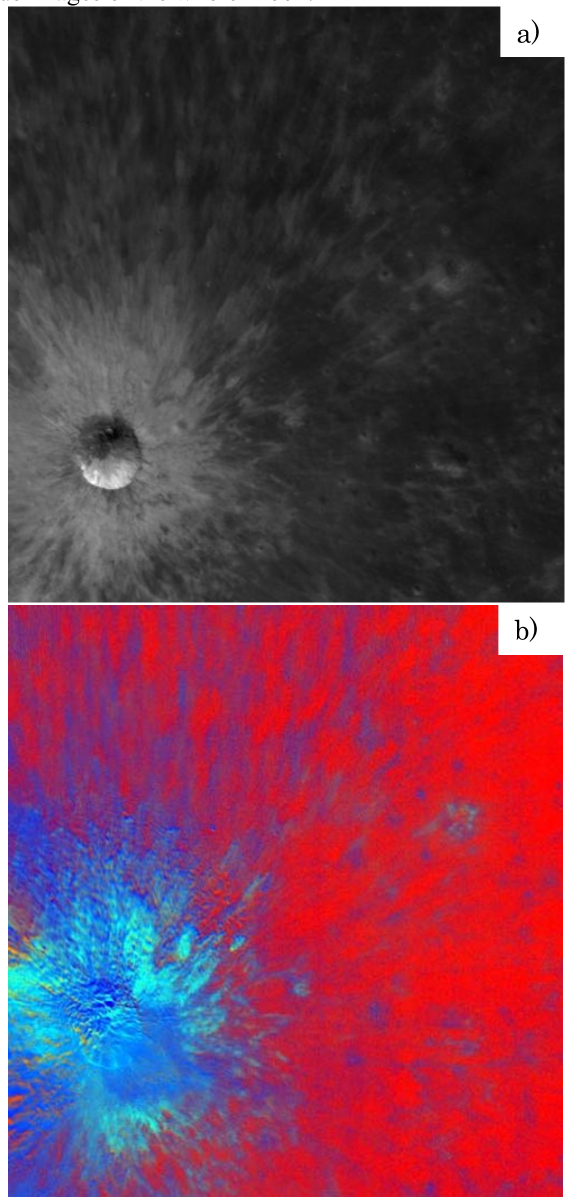

Fig. 2. MI-VIS image (spatial resolution is 20 m/pixel) of a small (1.5 km in diameter) crater located at 36° S, 240° E. a) 750 nm band image, and b) color ratio composite with R= 750/415 nm, G= 750/950 nm and B= 415/750 nm. Heterogeneous distribution of ejecta near the crater rim is clearly showed in band ratio image.

References: [1] Ohtake M. et al. (in print). [2] Kodama S. et al. (in prep). [3] Pieters C. M. and Tompkins S (1999) *J.Geophys. Res.*, 104, E9, 21,935-21,949. [4] Takeda H. et al. (2004) *LPS XXXVI*, Abstract # 1222. [5] Takeda H. et al. (2006) EPSL, 247, 171 – 184.