ANORTHOSITE WITH 100% PLAGIOCLASE ON THE MOON DETECTED BY THE SELENE MULTIBAND IMAGER. M. Ohtake[1], T. Mastunaga[2], Y. Yokota[1], J. Haruyama[1], H. Miyamoto[3], T. Arai[3], N. Hirata[4], H. Takeda[5], R. Nakamura[6], T. Morota[1], C. Honda[1], Y. Ogawa[2], K. Kitazato[7] and LISM Team, [1] Planetary Science Department, Japan Aerospace Exploration Agency, 3-1-1 Yoshinodai, Sagamihara, Kanagawa, 229-8510, Japan (ohtake.makiko@jaxa.jp), [2]The National Institute for Environmental Studies, [3]University Museum, University of Tokyo, [4]The University of Aizu, [5]Research Inst., Chiba Inst. of Technology, [6]National Institute of Advanced Industrial Science and Technology, [7]Graduate School of Science, Kobe University.

Introduction: A magma ocean hypothesis has been the most widely accepted mechanisms to generate a lunar highland crust. The basis for this hypothesis comes from analyses of returned-samples [1]. The hypothesis is now further supported by 1) high abundance of feldspathic rocks among randomly-sampled lunar meteorites [2]; and 2) 70 % of the moon surface are covered by Mafic poor, Fe depleted rocks from the Earth-based telescope and remote sensing data by Lunar Prospector and Clementine [3][4].

This hypothesis requires an assumption that Fe-bearing plagioclase-rich rocks globally exist as the lunar crust. However, no crystalline plagioclase has been detected by remote-sensing methods before SELENE [5], except for some ambiguous or indirect indications of existence of plagioclase. Lack of absorption band in previous observation is explained by several reasons, such as plagioclase with low Fe contents, shock deformation [6] and space weathering [7]. To investigate if Fe-bearing plagioclase-rich rocks globally exist is important, because this is the fundamental assumption for the magma-ocean hypothesis.

Global measurement at higher resolution is required for critically verifying this issue. We started the measurement by using newly acquired lunar remote sensing data taken by Multiband Imager (MI) on board SELENE [8] and one result of the ongoing study will be reported below.

MI is a high-resolution multiband imaging camera consisting of visible and near-infrared sensors (spectral band assignments are 415, 750, 900, 950 and 1000 nm for visible and 1000, 1050, 1250 and 1550 nm for near infrared). MI takes push-broom imaging data by using selected lines of area arrays. 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.

First lunar images by MI were taken successfully on November 3, 2007 during check out period of the SELENE mission. Since the first nominal observation started on January 18, MI has been covered more than 95 % of the whole moon. MTF, dark current, flat field, responsibility and other performance have been checked and were confirmed to be good and have not change drastically compare to the pre-flight test data.

Data processing and calibration: Tycho (43°S, 349°E; D=85 km) crater central peak, which located in nearside of the moon and is a Copernican-age crater located on the nearside of the Moon are analyzed in this study. Data we use were taken in March 23, 2008.

We calibrate MI data with the laboratory reflectance measurements of Apollo 16 soil samples [9].The photometric function proposed by [10] is used to convert the obtained data into the standard viewing geometry. The coefficients for 1000 nm by [10] are adopted to correct the observed intensities at 1050, 1250, and 1550 nm bands. Band images and all spectra presented here are after photometric correction with detailed topography. Digital terrain model (DTM) is generated from MI band sets that have 11.2 degree maximum parallax.

To minimize small scale topographic effect which can not fully corrected by using DTM, averaged values of 6 x 6 pixels of VIS spatial resolution are used for all spectra except mentioned otherwise.

In color-composite images, red, green, and blue are assigned to the absorption depths at 950 nm (pyroxene), 1050 nm (olivine), and 1250 nm (plagioclase), respectively, after the continuum removal.

Results: Figure 1A and 1B are MI 750 nm-band images and 1C is color-composite images of Tycho central peak. Figure 1 D is a color-composite bird's-eye-view image generated by using MI DTM. Reflectance spectra at 4 representative locations are presented in Fig. 2A and 2B. Spectrum after binning to 2 km/pixel resolution (which correspond to optimum spatial resolution for the Earth-based telescope) at Tycho_3 is also presented in Fig. 2 to evaluate effect of spatial resolution.

Most of the central peak consists of a rock type which contains high-Ca pyroxene (yellow). This result is consistent to the previous studies [11]. We also find exceptionally feldspathic rock with ~100% Fe-bearing plagioclase (bluish in color-composite) is exposed at the base of central peak (Tycho_3 in Fig. 2). Estimated modal abundance using mixing model [12] in this area are 98 vol. %. At the summit of the central peak, impact melt pond and melt flow like texture are observed (Fig. 1B). This observation is consistent to spectral similarity observed as green color both at the summit and at the floor (Fig.1C and 1D).

Spectral difference between different spatial resolution clearly demonstrate dilution of plagioclase absorption band at 1250 nm by averaged with spectra of surrounding material (Fig. 2).

Discussion: From the evidence that I) three different units with different compositions are observed at the central peak, and II) the actual crater central peak material possibly be covered by impact melt which generated by the Tycho generated impact event, to estimate actual crustal composition very careful analyses is required to identify and distinguish these under layered crustal material from over layered impact melt. Furthermore to analyze these central peak areas topographic reflectance correction is important because actual crustal material tend to be newly exposed at the sloped area.

From our results reason of the lack of Fe-baring crystalline plagioclase absorption band in previous observations appears to be limited spatial resolution and/or limited wavelength coverage.

Our finding of prominent plagioclase absorption band indicate that these crater central peaks neither suffer impact shock more than 20 GPa (because shock pressure more than 20 GPa will eliminate the plagioclase absorption band [14]) nor intensive space weathering effect.

We are conducting similar analyses at other locations including Jackson, Orientale and many other locations and those results indicate ~100% Fe-bearing crystalline plagioclase rock commonly exist throughout the moon.

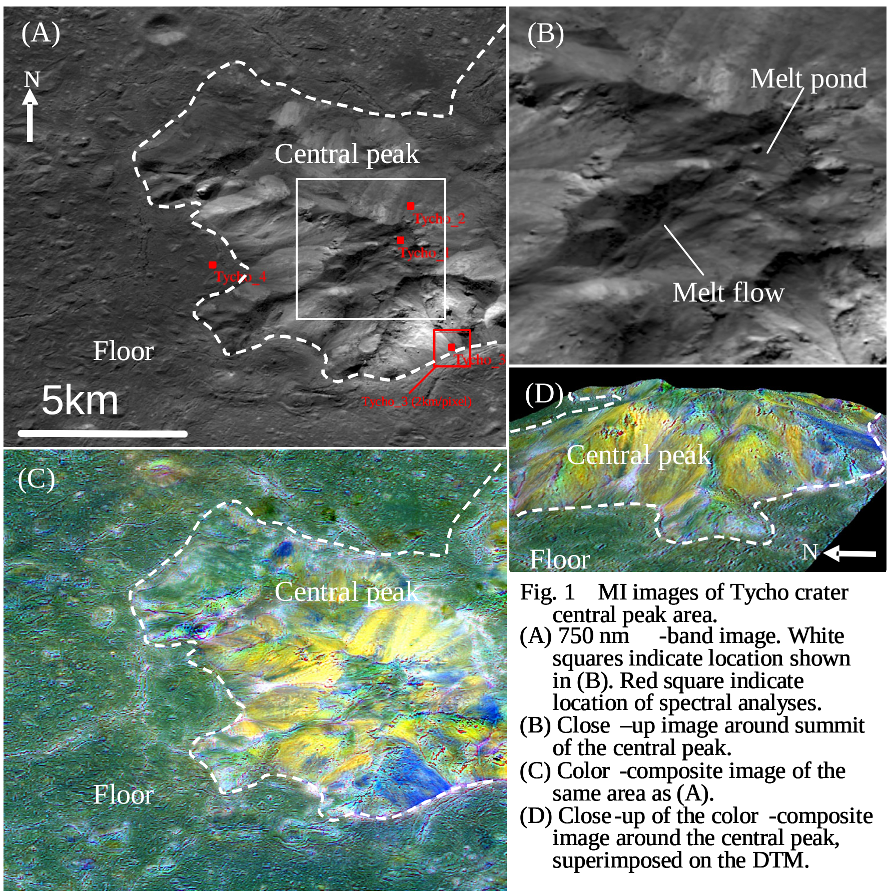

Fig. 1 MI images of Tycho crater central peak area.
(A) 750 nm -band image. White squares indicate location shown in (B). Red square indicate location of spectral analyses.
(B) Close –up image around summit of the central peak.
(C) Color -composite image of the same area as (A).
(D) Close-up of the color -composite image around the central peak, superimposed on the DTM.

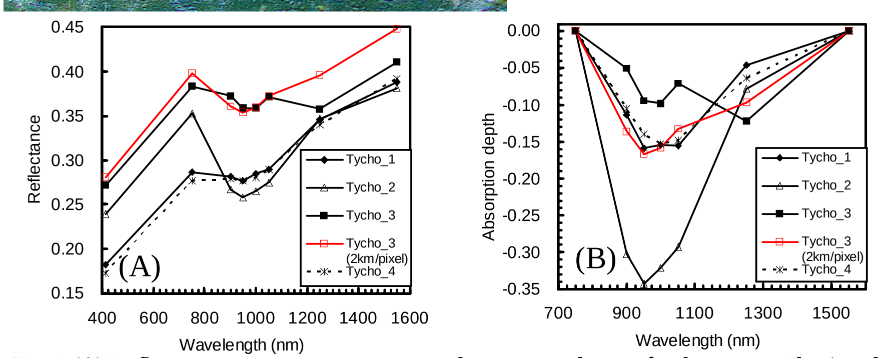

Fig. 2 (A) Reflectance spectra at representative locations with one after binning to 2km/pixel. (B) Absorption depths at same locations in (A) vs. wavelengths after the continuum removals.

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