DISTRIBUTION OF PUREST ANORTHOSITE ON THE ENTIRE LUNAR SURFACE. M. Ohtake[1], T. Mastunaga[2], H. Takeda[3], Y. Yokota[1], S. Yamamoto[2], T. Morota[1], Y. Ogawa[4], T. Hiroi[5], R. Nakamura[6] and J. Haruyama[1], [1]Planetary Science Department, Japan Aerospace Exploration Agency, 3-1-1 Yoshinodai, Sagamihara, Kanagawa, 229-8510, Japan (ohtake.makiko@jaxa.jp), [2]National Institute for Environmental Studies, [3]Chiba Inst. of Technology, [4]The University of Aizu, [5]Brown University, [6]National Institute of Advanced Industrial Science and Technology.

Introduction: The magma ocean hypothesis has been the most widely accepted mechanism explaining the generation of a lunar highland crust. This hypothesis is based on analyses of returned-samples [1]. The hypothesis is now further supported by findings from Earth-based telescope and remote sensing data acquired by Lunar Prospector and Clementine of 1) a high abundance of feldspathic rocks among randomly-sampled lunar meteorites [2][3], and 2) that 70 % of the Moon's surface is covered by Mafic poor, Fe-depleted rocks [4][5].

The magma ocean hypothesis is based on an assumption that Fe-bearing plagioclase-rich rocks exists globally as the lunar crust. However, no crystalline plagioclase had been detected by remote-sensing methods before SELENE [6], except for some ambiguous or indirect indications of the existence of plagioclase. However, the global distribution of rocks of very high plagioclase abundance (approaching 100 vol.%; purest anorthosite) was reported at central peaks, crater walls, and ejecta using an unambiguous plagioclase absorption band recorded by the SELENE Multiband Imager (MI) [7]. The estimated plagioclase abundance is significantly higher than previous estimates of 82 to 92 vol.% [1], providing a valuable constraint on models of lunar magma ocean evolution.

In this study, we further surveyed the distribution of the purest anorthosite over the entire lunar surface by using continuous reflectance spectra derived by the SELENE Spectral Profiler (SP) [6]. Knowing the entire distribution of the purest anorthosite may enable us to estimate the abundance of the purest anorthosite (PAN) rocks within the upper crust.

Data: SP is a line-profiling sensor with spectral coverage from 0.5 to 2500 nm and a spectral resolution of 6 nm in the visible wavelength range and 10 nm in the near-infrared wavelength range. SP's foot print is about 500 m x 500 m. SP observed the illuminated side of the Moon every orbit (about 7000 orbits) throughout SELENE mission periods except checkout. All of the observed SP data except data for calibration were used in this study (during one orbit roughly 10,000 spectra are acquired). These data were mixtures taken at various phase angles. The average gap size in the longitude direction between each SP observation line, which means gaps between each SELENE orbit, is about 2 km.

SP data were used here because its spectral resolution is higher than that of MI and SP is better able to detect the absorption center wavelength to detect the plagioclase absorption band even under very weak conditions.

Data analyses:

We calibrated SP data with the laboratory reflectance measurements of Apollo 16 soil samples [8]. Photometric function correction was not applied for the data.

SP spectra with reflectance at 750 nm below 5% were omitted from the data sets because of the lower S/N of these data. The absorption depth of each wavelength was calculated after the continuum was removed. Spectra with the greatest absorption depth around 1250 nm were ultimately selected to detect the purest anorthosite (>98 vol.%). The purest anorthosite spectra can be detected by this method because only rocks with high plagioclase abundance have this spectral feature caused by the plagioclase absorption band generated by a minor amount of Fe^{2+} (0.1wt% FeO) contained in the plagioclase. The plagioclase absorption band is located around 1250 nm (1300 nm is reported in [9] for terrestrial anorthite) so we allowed a wavelength range of the absorption center (from 1180 to 1300 nm) to accommodate possible compositional variation of the absorption center wavelength.

Results: Figure 1 depicts locations of detected PAN rocks (blue squares). Figure 2 depicts absorption depths at three representative spectra after the continuum removals. About 400 spectra were selected using the above definitions. Within these selected spectra, the wavelength of the greatest absorption depth indicates variation among locations but suggests no heterogeneity on global scale like the near side and far side. All wavelengths at the greatest absorption depth are shorter than 1260 nm in our analyses of these 400 spectra.

As presented in Fig. 1, the PAN rocks are distributed globally and relatively homogeneously within the highland region. The PAN rocks were found both on the near side and the far side, but on the near side the presence appears to be limited to locations around rims of large basins compared to the more randomly distributed far side distribution which is consistent to the previous study [10]. Some of the locations where PAN rocks are found in MI data [7] are missing in Fig. 1 (for example, Tycho) because outcrops of the PAN

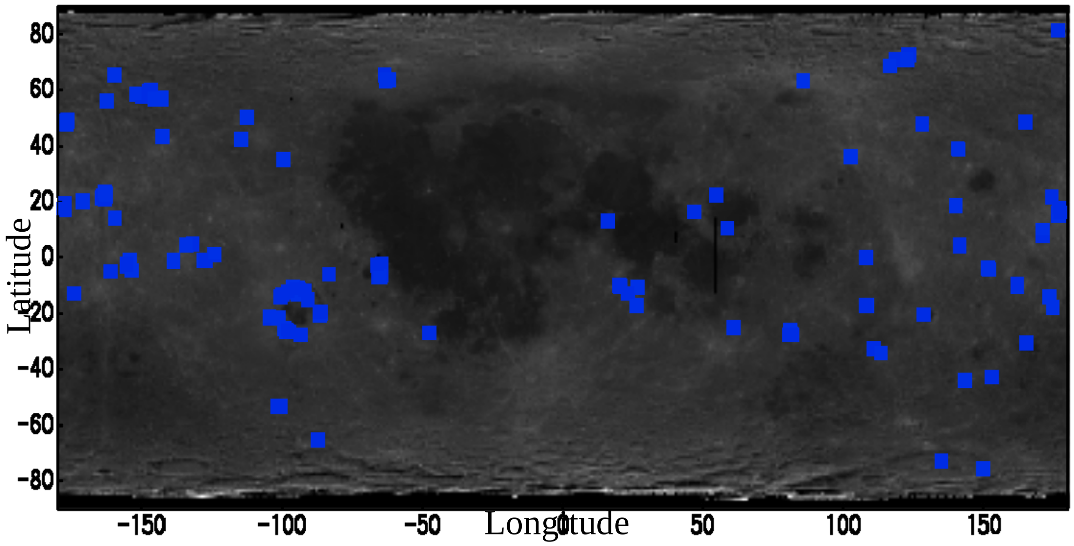

Fig. 1 Distribution of detected PAN rocks derived by the SELENE SP.
Blue squares indicate locations of the PAN rocks plotted on the SP 750 nm map. About 400 locations (spectra) were selected from all SP data by definitions discussed in the text.

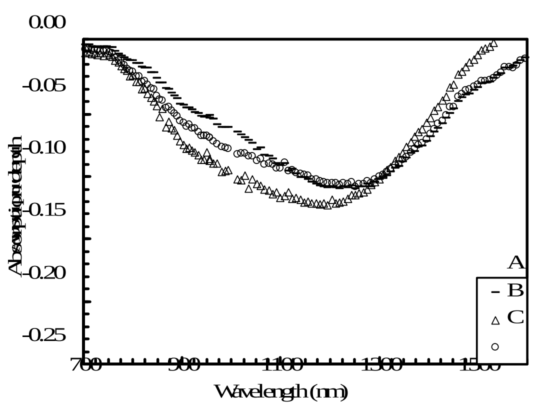

Fig. 2 Absorption depths at three representative spectra versus wavelengths after the continuum removals. Locations of each spectrum are A (-65.0, -6.5), B (-63.2, 63.5), and C (151.7, -3.9).

acquired for these outcrops. There is no apparent latitude dependence in the PAN rock distribution.

Discussion: To precisely estimate the modal abundance of rocks at each location presented in Fig. 1, more detailed spectral analyses and check for spatial mixing of anorthosite rocks with surrounded non-anorthosite material are required. However, current results indicate a relatively homogeneous distribution and large number of outcrops of the PAN rocks found throughout the lunar surface, supporting the high abundance of PAN rocks within the upper crust.

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