Mineralogy and Mg# of the Chang'E 5 landing region. Lingzhi Sun[1], Paul G. Lucey[1], [1]Hawai'i Institute of Geophysics and Planetology, University of Hawai'i at Mānoa, Honolulu, HI, USA, lzsun@higp.hawaii.edu.

Introduction: The Chinese Chang'E-5 (CE5) mission successfully returned ~2 kg lunar regolith from the Northern area of the Oceanus Procellarum mare (43.06°N, 308.08°E, NASA/GSFC/ASU). This mare unit was formed less than 2 billion years ago, and it is among the youngest basaltic lava flow on the Moon [1]. Mare basalts are usually formed from volcanic eruptions with source region at the mantle, thus their composition may be related with the mantle compositions at different evolution stage. The Oceanus Procellarum-Imbrium region is enriched with radioactive elements like K, Th and U, which slowed the solidification of the mantle. The return of young mare basalts is significant in understanding the late-stage thermal evolution of the lunar mantle.

In this work, we report the composition, mineralogy and chemistry of the Chang'E 5 landing area using both spectral data acquired by the Multiband Imager (MI) on board Kaguya and the Moon Mineralogy Mapper (M^3) on board Chandrayaan-1.

Composition of the landing area: Based on data from Lunar Prospector Gamma-Ray spectrometer [2], the FeO and TiO_2 abundances of the landing site are 22.4 wt% and 4.5 wt%., and the Mg# is about 50 [2], which are similar to the high-FeO and intermediate-TiO_2 soil found at the Chang'E 3 landing area in northern Imbrium [3]. TiO_2 abundance from the LROC WAC data show a higher value around 6.6 wt% [4].

Fig.1 shows the mineral maps of the landing area derived from the Multiband Imager data (20 m/pixel) using the Lemelin et al. (2015) method. The basalts in this area have relatively uniform mineralogy distributions. The modal mineral abundances at the landing site are: olivine = 15.5 vol%, orthopyroxene (OPX) = 8.4 vol%, clinopyroxene (CPX) = 32.7 vol%, and plagioclase = 43.5 vol%.

It is possible that the landing area contains ejecta from the nearby feldspathic kipuka to the south, which may be residual of a ghost crater [5]. The modal mineral abundance of this kipuka is: olivine = 8 vol%, OPX = 21.3 vol%, CPX = 19.5 vol%, and plagioclase = 51.1 vol%. Comparing to the landing site, this kipuka is less abundance in olivine, but contains much more OPX.

Mineral and Mg# distribution with depth: To determine the mineralogy variation with depth in this mare unit, we selected thirty-five craters with excavation depth varying from 24 m to 160 m on both MI and the Moon Mineralogy Mapper images (assume an excavation depth of 1/10 of the crater diameter). The location of the craters is shown in Fig. 2. For each crater, we extracted their mineral abundances from MI mineral maps [6]. We then geometrically correlated the M^3 image to the MI map, and extracted the spectra of the craters on M^3 images (Fig. 3). We used the spectral library introduced in [7] and calculated the Mg# for these craters. Fig. 4 shows the variation of olivine, OPX, CPX , plagioclase and Mg# with the crater excavation depths. Even though each mineral varies within ~10 vol%, no obvious change in mineral abundances or Mg# with depth is observed, implying that these thirty-five craters may have sampled the uppermost layer of lava flow, or that there are only minor variations in mineralogy between different lava flow layers in this area.

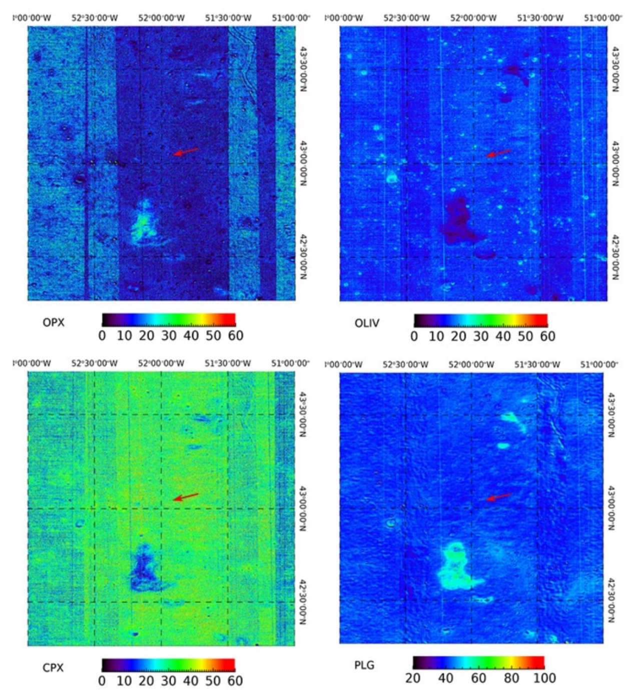

Fig. 1 Mineral images from Lemelin et al. (2015). The red arrows point to the landing site of Chang'E 5.

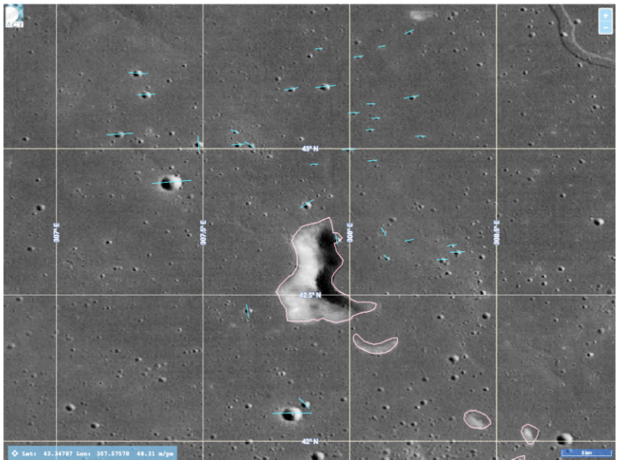

Fig.2 Location of 35 selected craters shown on LROC WAC map [NASA/GSFC/ASU].

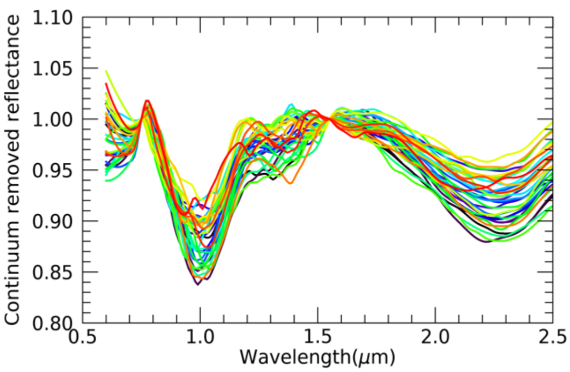

Fig. 3 M^3 spectra of the thirty-five craters in Fig.2.

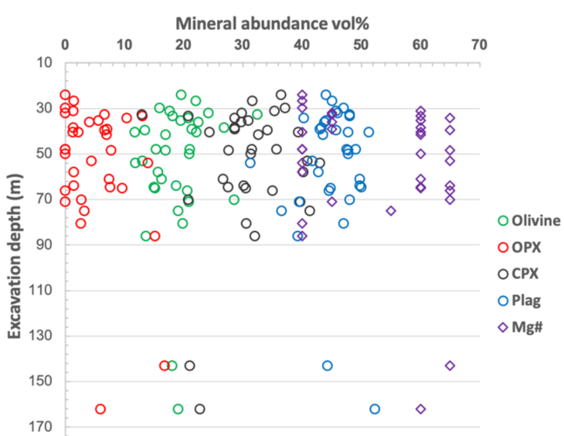

Fig.4 Mineral and Mg# variation with the excavation depth of craters.

Discussion and Conclusion: The mineralogy and composition of the Chang'E 5 landing area are relatively uniform. The mare basalts in this area contain abundant olivine and clinopyroxene. Craters with excavation depth raging form 20-160 meter did not expose a lava flow layer with different mineralogy. The low Mg# (~50) of this area indicates that the parent magma of the basalts is highly evolved. The basalts in this area may have similar origin to that of the Chang'E 3 landing area, which may due to the mixing of the magma ocean late stage ilmenite and clinopyroxene-bearing cumulates and the primitive olivine and orthopyroxene-bearing cumulates [3, 8].

References:

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