MINERALOGY OF MARE SERENITATIS. W. Cai[1], Y. Z. Wu[2], X. M. Zhang[1], Y. Lu[1]. [1]School of Geographic and Oceanographic Sciences, Nanjing University, Nanjing, 210023, China (caiweinju@foxmail.com), [2]Key Laboratory of Planetary Sciences, Purple Mountain Observatory, Chinese Academy of Sciences, Nanjing 210008, China.

Introduction: The thermal evolution of the Moon is recorded by mineral composition of mare basalt [1]. Moreover, through study of mare basalt we could know more about the physical and chemical environment of the rock's formation, which is helpful for the development of lunar resource.

Hiesinger used Galileo Earth/Moon Encounter (EM2) image to map 27 geological units in Mare Serenitatis and obtained model ages of surface units by crater size-frequency distribution (CSFD) [2]. Hackwill identified and delineated boundaries of basaltic units with the wide variations in FeO wt%, TiO_2 wt% and Clementine false color images [3]. The whole basaltic units were 14, the youngest units located in the northeast part of Mare Serenitatis. Kaur got 13 basaltic units through Moon Mineralogy Mapper (M^3) and M^3 integrated band depth (IBD) data [4].

In this study, multi-source remote sensing data were used to delineate geological unit in Mare Serenitatis and the absorption characteristics of fresh crater was extracted by M^3 data, which contribute to not only identify the mineral composition but also discuss its regional geological significance.

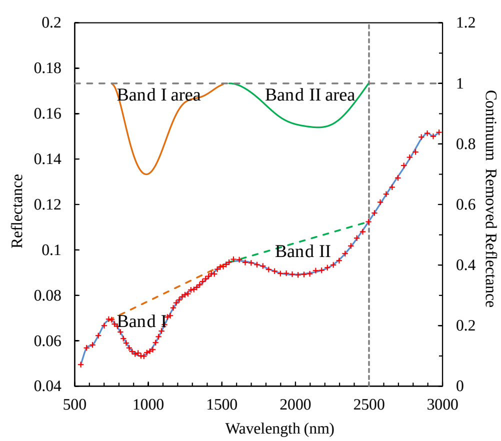

Fig. 1 Example of continuum removal and de-noising for the spectrum truncated at 2497 nm

Data and method: The accurate separation of basaltic units is very crucial to date ages, interpret surface geology and investigate thermal evolution [5]. A variety of orbital remote sensing data was used in this study such as M^3, M^3 IBD, Chang'E-1 Interference Imaging Spectrometer (IIM), Lunar Reconnaissance Orbiter Camera (LROC) Wide Angle Camera (WAC) data and Clementine ratio data to delineate more reliable geologic units. The hue of IBD revealed the absorption features of rock. From Clementine ratio data, different colors reflect the composition information. But in mapping geologic units, this is impossible using the traditional Clementine color ratio image and M^3 IBD image because the basalts of approximately similar ages often have similar compositions and spectral color and hence are difficult to separate based on the spectral data only. So multi-source remote sensing imagery was beneficial to map it. The next step was extracting spectra of fresh crater from M^3 data. Following the method suggested in [6], we select the resolvable small fresh crater (about 300~500 m) and from one pixel only to avoid mature soil and reduce the spectral mixing. At last, the spectral parameters were acquired. There were numerous waveform parameters to describe mineral absorption spectral features. In this study, absorption center and absorption band area ratio (BAR) were obtained through data processing to acquire mineral variation of Mare Serenitatis basalt. Smoothed by B Spline smoothing, the spectra reduced the effect of noise. Continuum removal contribute to reduce the effect of thermal radiation. Figure 1 shows the method of continuum removal. Constructed two straight lines across Band I and Band II, which was tangent to the left and right shoulder of the absorption except the point on the right of Band II truncated at 2497 nm [7].

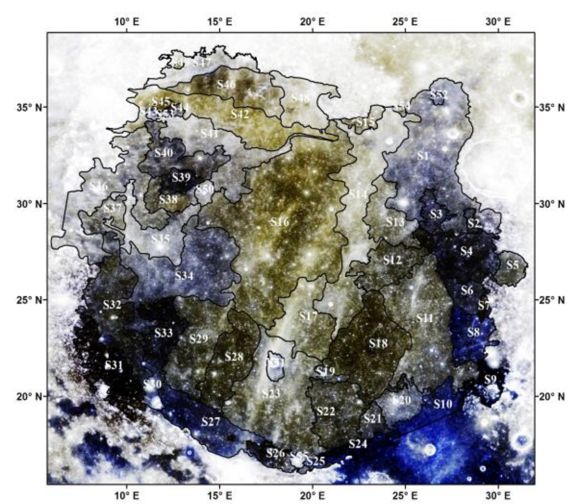

Fig. 2: Sketch map of the geologic units in Mare Serenitatis

Results: According to above-mentioned method and previous geological unit [2-4], we divided 55 geological units including few small units which were thought volcanic vent such as S49 and S52. Figure 2 showed the geologic units in Mare Serenitatis whose base map was LROC WAC 7 band composite (R, 689nm, G, 566nm, B, 321nm). Considered of locations, we set 4

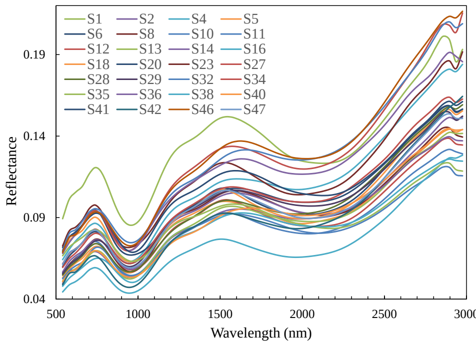

Fig. 3 Mean reflectance spectra of each unit

groups including G1 which is consisting of units S1, S2, S4, S5, S6, S8; G2 which is consisting of units S32, S34, S35, S36, S38, S40, S41; units S10, S27 are in G3; the other units are divided into G4. G1 and G2 have similar reflectance spectra which are in east and west of Mare Serenitatis. G3 has too little sample size. G4 has stronger absorption in 2000nm than G1 and G2. Figure 3 shows some reflectance spectra of fresh crater. The spectral curve shows good consistency which was strong absorption at 1000nm and 2000nm and weak absorption at 1300nm. Figure 4 shows that the band centers of Mare Serenitatis vary from 950-979 nm in Band I and from 2005-2174 nm in Band II. It also shows

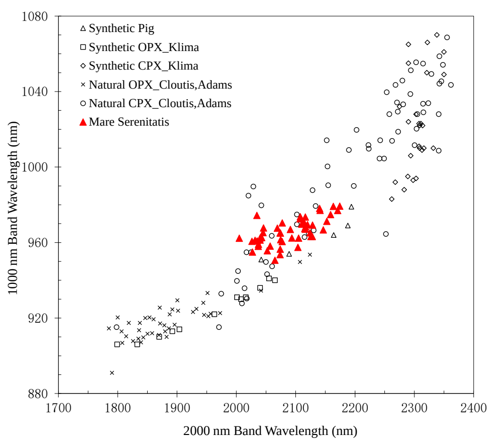

Fig. 4 The plot of Band II centers versus Band I centers

the spectra of synthetic pyroxene and nature pyroxene in laboratory as compared [8-10]. The 1000nm and 2000nm absorption center of low-Ca pyroxene vary from 900 nm-930 nm and 1800 nm-2100 nm while high-Ca pyroxene is 910 nm-1070 nm and 1970 nm-2360 nm. Unfortunately, we only study 28 geologic units. Because of some units are too small to choose the fresh crater which is matched condition. It is rich in clinopyroxene (CPX), but calcium content is lower than laboratory sample. According to [11], in Figure 5 BAR values range from 0.5~1.2 meanwhile 1000nm absorption curve value range from 950~980, which probably indicates the olivine-clinopyroxene.

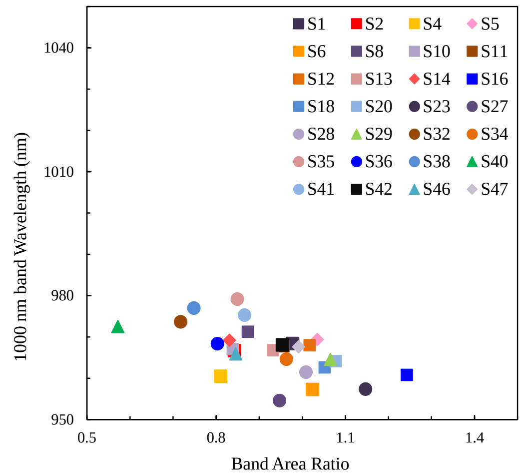

Fig. 5 Plot of BAR versus Band I center

Summary: Combined with the reflectance spectra, Band II centers versus Band I centers and Bar versus Band I center, it could be attributed to the presence of olivine-clinopyroxene mixtures. The clinopyroxene composition is dominated in high-Ca pyroxene in Mare Serenitatis.

Outlook: In future work, more fresh craters will be found to make sure the accuracy of mineral analysis because of there are no fresh crater to be selected in some geologic units. The age of each geologic units could be measured, which is helpful to study the mineral composition.

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