NEW VIEWS OF LUNAR COMPOSITIONS AND ROCK TYPES REVEALED BY SPECTROSCOPIC DATA FROM CHANG'E-1 AND CHANG'E-3 MISSIONS. Zongcheng Ling[1,2], Bradley L. Jolliff[2]. [1]Shandong Provincial Key Laboratory of Optical Astronomy and Solar-Terrestrial Environment, Institute of Space Sciences, Shandong University, Weihai, 264209, China; [2]Dept Earth & Planetary Sciences and McDonnell Center for the Space Sciences, Washington University in St. Louis; (zcling@sdu.edu.cn).

Introduction: Our initial direct knowledge about lunar compositions and mineralogies arises from the lunar samples at 9 sites from Apollo and Luna missions 50 years ago. In the early 21st century, newly acquired datasets from lunar missions (e.g., Kaguya, Chang'e, Chandrayaan-1, and LRO) have advanced our knowledge (especially the global view) of the Moon's surface materials. Planetary spectrometers can provide detailed compositional and mineralogical information of the surface materials and thus has been one of the primary payloads for planetary orbiting and surface exploration missions (e.g., Chandrayann-1 M^3 [1], Kaguya MI [2], MRO CRISM [3], MER Pancam[4], etc.). Here we review some of the science returns from the three payloads of Chang'e-1 and Chang'e-3 Yutu rover, i.e., Imaging Interferometer (IIM), Visible and Near-infrared Imaging Spectrometer (VNIS), and Active Particle-induced X-ray Spectrometer (APXS).

Chang'e-1 IIM results: As the first Chinese lunar imaging spectrometer, Chang'e-1 IIM has science goals to collect information on chemical and mineralogical compositions across the lunar surface [5]. IIM is a Fourier transform Sagnac-based imaging spectrometer first used for a lunar investigation and has already shown its potential for acquiring 32 bands in the visible to near infrared spectral range (0.48-0.96 μm). Preliminary lunar FeO, TiO_2, and rock type maps have been derived using this dataset [5-9]. However, the IIM data processing procedures are still ongoing, e.g., we have presented the empirical correction method of correction for the line-direction (i.e., “flat-field correction”) and sample-direction (i.e., “spectral calibration”) non-uniformities [10-12], which have not been removed completely by previous data processing procedures. Fig. 1 shows our newly produced lunar global FeO distribution indicating well known inhomogenities across the lunar highlands, but in detail different from previous Clementine UVVIS FeO maps.

Chang'e-3 VNIS and APXS results: China's Chang'e-3 conducted the first lunar surface landing and roving mission after some forty years and provides new ground truth and discoveries [13-18]. VNIS data taken by the Yutu rover acquired mineral compositions along the traverse route, together with chemical compositions from APXS. With these data, we found a new type of lunar basaltic rock, intermediate in Ti and rich in olivine, distinct from samples returned by Apollo and Luna missions as well as lunar meteorites [18]. The study used the APXS to detect the elemental concentrations of two sites (i.e., CE3-0006 and CE3-0008). Mineral modes and mineral chemistries inferred from these data are consistent between the APXS and VNIS, thus making the Chang'e-3 site (i.e., "Guang Han Gong") a good calibration site for the lunar remote sensing studies.

Conclusions: Global hyperspectral imaging datasets from Chang'e-1 IIM have brought new science returns of lunar surface compositions and rock types, thus leading to a better understanding of lunar petrogenesis and crustal evolution. The in-situ spectroscopic measurements by Yutu yielded detailed compositional and mineralogical constraints of a new type of young basaltic rock. Future in-depth studies of these datasets from the Chang'e missions in combination with other datasets will improve our view of the Moon.

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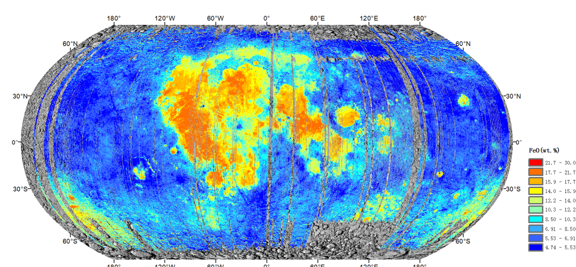

Figure 1. Global lunar FeO derived from Chang'e-1 IIM data