Diverse Rock Types Detected in the Lunar South Pole-Aitken Basin by the Chang'E-4 lunar mission. Jun Huang[1,2*], Zhiyong Xiao[3,2,4*], Long Xiao[1,2,4*], Briony Horgan[5], Xiaoyi Hu[1], Paul Lucey[6], Xiao Xiao[1], Siyuan Zhao[1], Yuqi Qian[1], Hao Zhang[1], Chunlai Li[7], Rui Xu[7], Zhiping He[7], Jianfeng Yang[8], Bin Xue[8], Qi He[1], Jie Zhong[9], Hongyu Lin[10], Changning Huang[10], Jianfeng Xie[11]. [1] State Key Laboratory of Geological Processes and Mineral Resources, Planetary Science Institute, School of Earth Sciences, China University of Geosciences (Wuhan), China. [2] CAS Center for Excellence in Comparative Planetology, China. [3] Planetary Environmental and Astrobiological Laboratory, School of Atmospheric Sciences, Sun Yat-sen University, China. [4] State Key Laboratory of Lunar and Planetary Sciences, Space Science Institute, Macau University of Science and Technology, China. [5] Department of Earth, Atmospheric and Planetary Sciences, Purdue University, USA. [6] Hawai'i Institute of Geophysics and Planetology, University of Hawai'i at Manoa, Honolulu, USA. [7] Key Laboratory of Space Active Opto-Electronics Technology, CAS Shanghai Institute of Technical Physics, China. [8] CAS Xi'an Institute of Optics and Precision Mechanics, China. [9] CAS Institute of Optics and Electronics, China. [10] CAST Beijing Institute of Space Mechanics and Electricity, China. [11] Beijing Aerospace Flight Control Center, China (junhuang@cug.edu.cn).

Introduction: South Pole-Aitken (SPA) basin, located between the South Pole and Aitken crater on the far side of the Moon, is the largest confirmed lunar impact structure. The pre-Nectarian SPA basin is a 2400-km-by-2050-km elliptical structure centered at 53ºS, 191ºE, which should have exposed lower crust and upper mantle due to enormous excavation depth. Olivine, the dominant mineral in the Earth's mantle, has only been identified in small and localized exposures in the margins of the SPA basin and the dominant mafic component is, instead, pyroxene. The mineralogical characteristics could be explained by the recent hypothesis that the lunar upper mantle is dominated by low-calcium pyroxene (LCP), not olivine. Here we present observations from imaging and spectral data of China's Chang'E-4 (CE-4) mission in the first 4 synodic days, especially the first in-situ visible/near infrared spectrometer (VNIS) observation of an exposed boulder. We have identified a variety of rock types, but not the recently reported olivine-rich materials in the landing region. The results are consistent with orbital observations. The obtained mineralogical information provides a better understanding of the nature and origin of SPA materials.

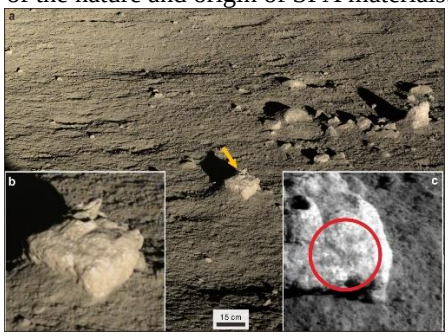

Figure 1. PCAM and VNIS visible observations of Qi Yuan(meaning "unexpected encounter" in Chinese), the first lunar rock for which a VNIS spectrum was obtained. (a) A group of relatively light-toned rocks. The half-buried rocks are likely exposed due to long-term mass wasting. Qi Yuan is indicated by the yellow arrow. (b) A blow-up view of Qi Yuan. It looks like a coherent igneous rock, and the bright spots on its relatively fresh surface are plagioclase phenocrysts or pits created by micro meteorite impacts. (c) VNIS visible image of Qi Yuan. The red circle indicates the footprint of the VNIS SWIR detector.

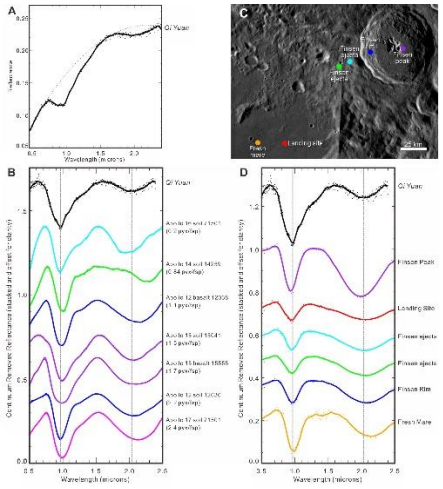

Figure 2. VNIS spectrum of Qi Yuan compared to Apollo samples and M3 spectra. (A) Reflectance spectrum of Qi Yuan, showing parabolic continuum fit (dashed line). (B) Comparison of continuum removed spectra of Qi Yuan and spectrally similar Apollo samples. Dashed vertical lines indicate band centers for Qi Yuan. (C) Regional NAC mosaic showing locations where M3 spectra were extracted. (D) Comparison of continuum removed spectra of Qi Yuan and M3 spectra from locations shown in (C). Qi Yuan is most similar to M3 spectra from the crater rim and proximal ejecta.

Notes: For the full text of this study, please refer to Huang et al., (2020). Diverse Rock Types Detected in the Lunar South Pole-Aitken Basin by the Chang'E-4 lunar mission. Geology, accepted. doi: 10.1130/G47280.1