DEPTH OF SMALL IMPACT CRATER ACROSS THE CHANG'E-5 LANDING AREA. Kun Fang, Le Qiao and Zongcheng Ling, [1]Shandong Key Laboratory of Optical Astronomy and Solar-Terrestrial Environment, School of Space Science and Physics, Shandong University, Weihai, 264209, China. (kun_fang@mail.sdu.edu.cn).

Introduction: Sample return is among the most advanced method to explore extraterrestrial bodies. Chang'e-5 is the first sampling return mission of China's lunar exploration program. The scientific objectives of the Chang'e-5 mission include determining the cessation time of lunar volcanism, assessing the composition of lunar late-state volcanism, and providing an insight into lunar thermal and interior evolution [1]. The landing site of Chang'e-5 (43.06°N, 51.92°W, [2]) is located in a flat and extensive lunar mare basalt unit, which had been dated to be ~1-2 Ga old from crater population studies. The mare unit across Chang'e-5 landing is much younger than all existing lunar basaltic samples, and among the youngest surface maria on the Moon. Therefore, the samples returned by Chang'e-5 have great potentials for understanding the geological and thermal evolution of the Moon.

The investigation of surface impact craters is of great importance for characterizing the surface and sub-surface properties of regional lunar surface [3]. The size and frequency of impact craters are often used to calculate the emplacement ages of surface deposits. Similar with the population of impact craters, the depth of impact craters can also provide fundamental information concerning many characteristics of the substrate including strength, density, and porosity. In addition, we can also use the degradation status of impact craters to constraining various geological processes on the Moon.

In this work, we investigate small craters (≥30 m in diameter) across the Chang'e-5 landing area using the latest high-resolution image and topography data. We map their population, measure their diameter (D) and depth (d) and calculate the d/D ratios. We also compare impact craters at Chang'e-5 area with those in other representative areas elsewhere on the Moon.

DATA and Method: The data used in this paper are the images taken by the Lunar Reconnaissance Orbiter Narrow-Angle Cameras (LROC NACs). On the basis of stereo imaging observations obtained by the NACs, the LROC team produce detailed and accurate digital terrain models (DTMs) of the lunar surface [4]. The image data used in this work are LROC NAC frames M1374421274L, M1348581418L, with a spatial resolution of ~1 m/pixel. The DTM data (ID: DTM_CHANGE501_E430N3081) generated from the two NAC images has a resolution of 3 m and a vertical precision of ~1 m.

We use the CraterTools software extension for ESRI's ArcGIS and LROC NAC data to identify and measure the diameters of impact craters (D ⩾ 30 m) across an ~4.6×8.3 km area surrounding the Chang-5 landing site (Fig. 1). These small craters are also classified into four types, named A, AB, B and C, according to their morphologies including rim, ejecta blanket, albedo contrasts with surrounding terrains, blocks, and ray patterns [5,6]. Class A craters are extremely fresh impact craters with crisp rims, apparent ejecta blanket, extensive blocks and clear ray features. Class AB craters are fresh impact craters, with apparent rims and a few blocks. Class B craters are somewhat degraded, while still with recognizable rims. The main difference between class B and AB craters is that no ejecta can be seen in class B impact crater. Class C craters are the most degraded impact craters. We also calculate the depth and depth/diameter ratios of impact crater in the Chang'e-5 landing area from the LROC NAC DTM topography data.

Results: In total, we counted 2602 impact crater in the Chang'e-5 landing area (Fig.1). Concerning the morphological classification, extremely fresh craters (Class A) are not identified, 137 impact craters (~5%) are classified into Class AB, 617 craters (~24%) are Class B and 1848 (~71%) are categorized as Class C.

The diameters of these craters are up to ~360 m (median diameter = ~55 m). The depths range from less than 1 m to nearly 60 m (median depth = 2.0 m). The d/D ratio vary from less than 0.01 to 0.17, with a median value of 0.04.

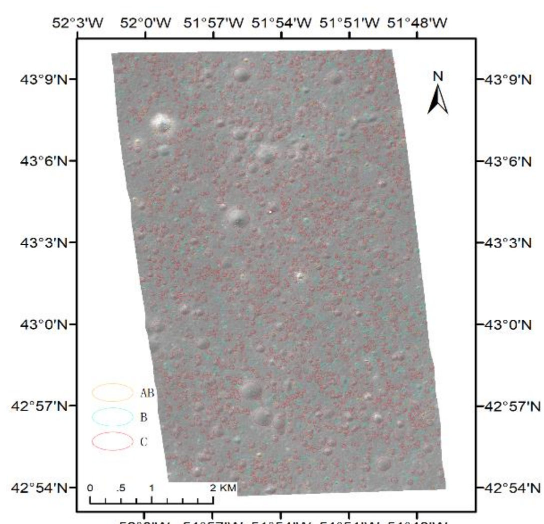

Fig.1. Spatial distribution of different types of impact craters across the Chang'e-5 landing area.

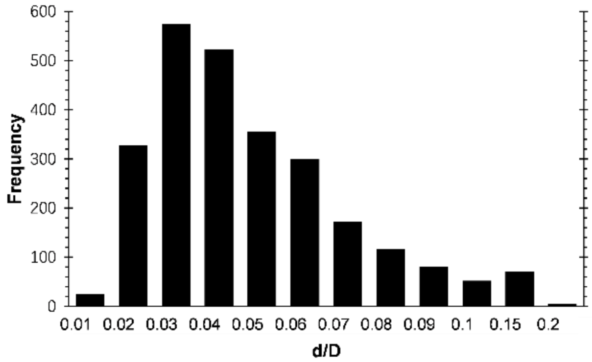

Fig.2. Depth/diameter ratio frequency distribution histogram of impact craters in the Chang'e-5 landing area.

The value of d/D can reflect the freshness of the impact craters, with fresh crater having greater d/D values. The histogram of d/D ratios of impact craters in the Chang'e-5 landing area is characterized by a unimodal and leptokurtic distribution pattern, peaking at 0.02-0.04 (Fig. 2). The d/D values for the majority of impact craters are <0.06 (Fig. 2 and 3). These values are much smaller than that of fresh impact craters on the Moon (~0.2, [6,7]), indicating that these small impact crater are subject to considerable degradation.

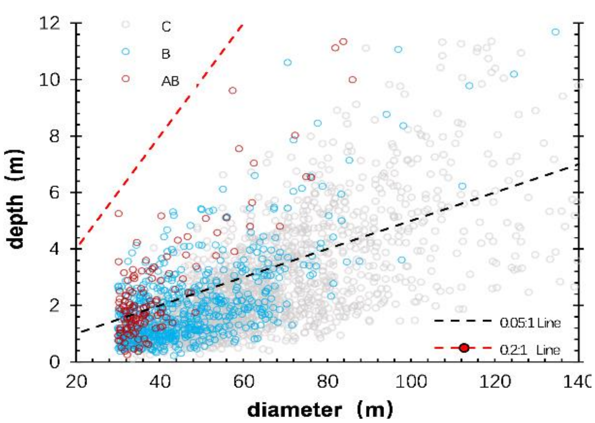

Fig.3. Plot of crater depth against diameter of the Chang'e-5 landing area.

Summary and Future Work: On the basis of mapping and measurement of small impact craters in the Chang'e-5 landing area, we find that the majority of these craters we selected are seriously degraded. In the future, we will explore the factors that generating the small d/D ratios and compared our results with craters in other regions on the Moon.

Reference: [1] Wang et al. (2021) *Remote Sens.* 13, 590. [2] Li et al., (2019) *Science* 365, 238-239. [3] Robbins et al. (2018) MAPS 53, 583-637. [4] Henriksen et al. (2016) *Icarus* 283, 122-137. [5] Basilevsky et al. (2015) 117, 385–400. [6] Stopar et al. (2017) *Icarus* 298, 34-48. [7] Daubar et al. (2014) *JGR* 119, 2620-2639.