LOCAL GEOLOGY OF CHANG'E-3 LANDING SITE FROM ANALYSIS OF THE CE-3 DESCENT CAMERA AND LROC NAC IMAGES. Yangxiaoyi Lu[1], Alexander Basilevsky[2] and Albert Abdrakhimov[2], [1] National Astronomical Observatories, CAS, 20A Datun Road, Chaoyang District, Beijing, China, 100012, lyxy@bao.ac.cn, [2] Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, 19 Kosygin St., Moscow, 119991, Russia, atbas@geokhi.ru.

Introduction: Chang'E-3 (CE-3) is a mission which on December 6, 2013, delivered to lunar surface the rover named Yutu (Chinese "Jade Rabbit"). Here we shortly describe local geology of the landing site based on analysis of images taken by the CE-3 descent camera and LROC NAC. The landing site (44.12°N, 19.50°W) is in the NW part of Mare Imbrium (Fig. 1). It is about 500 km NE from the landing site of Luna 17 which delivered to lunar surface Lunokhod 1 [1].

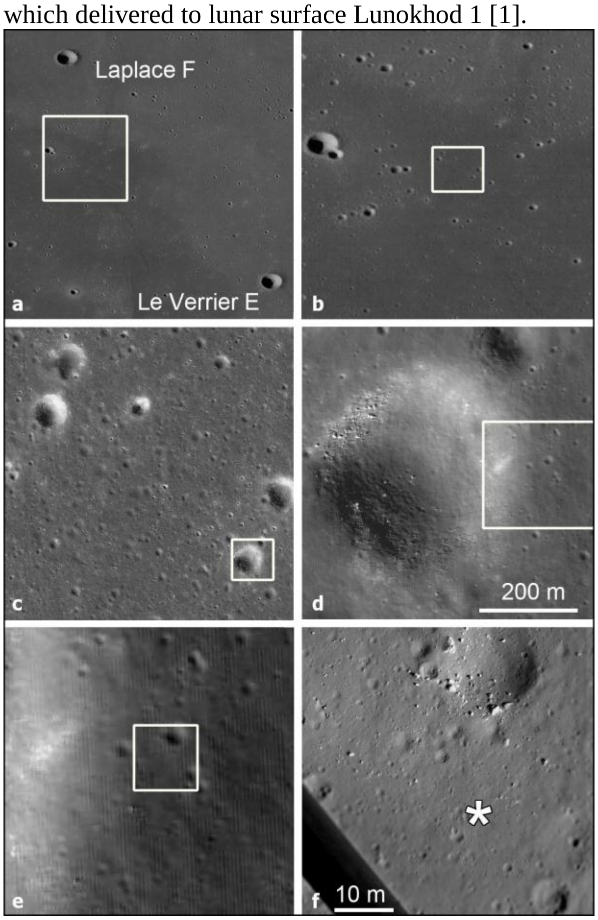

Figure 1. Regional to local contexts of the Chang'E-3 landing site (white star in framelet f); a-e) parts of LROC NAC images, M104640386RE, M190738378LE, M183661683LE, M1129602407LE, M181302794LE, correspondingly, f) image taken by the Chang'E-3 descent camera shortly before landing.

It is seen in Figure 1 that Chang'E-3 landed on the eastern rim of the crater of ~450 m in diameter in ~50 m east from the crater rim-crest. The lander reached the relatively smooth subhorizontal surface complicated with craters from decimeters to 1-2 m in diameter and rare rock fragments a few decimeters across. Figure 2 is a color anaglyph showing the 450-m crater on which Chang'E-3 landed.

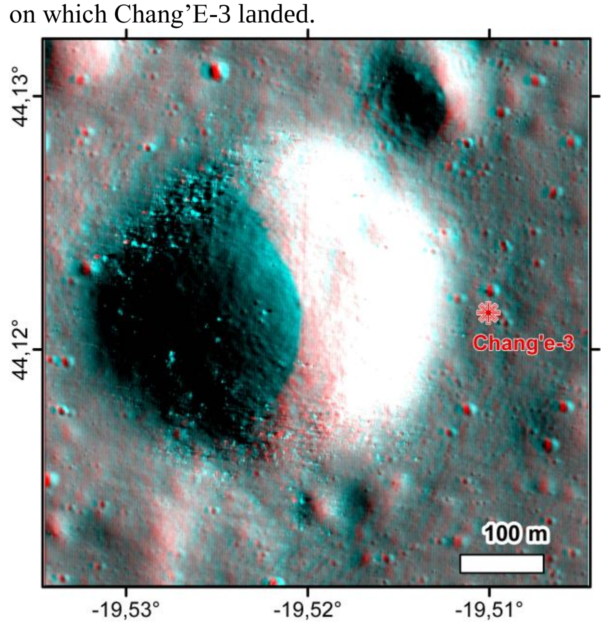

Figure 2. Anaglyph showing the crater on the eastern rim of which CE-3 landed. Composed of LROC NAC images M102285549LC and M181302784LE.

The terrain analysis: The mentioned 450-m crater has internal slopes covered with rock fragments from a few decimeters to a few meters across. They are seen in particular, in the crater inner slopes in its eastern segment (Figure 3).

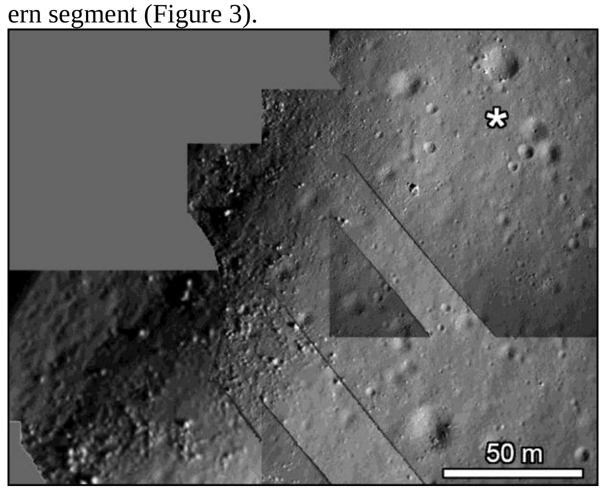

Figure 3. Mosaic of images taken by the CE-3 descent camera. White star shows the landing site.

The CE-3 descent images were taken at the Sun elevation ~24^{o}. In some places of the crater inner slopes is seen the dark semishadow (Figure 3) suggesting that the slope there is close to 24^{o}. On the LROC NAC image M181302784LE (Sun elevation ~19^{o}) is seen that part of the crater inner slopes in its western segment is in deep shadow. On the image M102285549LC (Sun elevation 9^{o}) it is seen that the shadow eastern end extends a little further than the crater center suggesting that the crater depth/diameter ratio is close to 1/6.

These characteristics of the considered crater imply that its morphological prominence corresponds to transition from morphologic class AB to class B [2,3]. This allows to estimate age of this crater as ~100 m.y. [3]. This means that the CE-3 landing area is geologically very young and the local soil here should be immature. The crater count ages for this part of Mare Imbrium are in between 3 and 3.5 b.y. [4].

Simple bowl shaped craters with diameter D typically excavate the target material from the depth down to ~1/10D [5, formula 5.5.4]. So the considered 450-m crater excavated the material from the depth down to 40-50 m. This is much below the typical lower boundary of lunar mare regolith [6]. So the crater ejecta have to contain numerous rock fragments but the boulders are not abundant on the crater rim surface although are present. This is obviously due to catastrophic destruction of rock boulders by small meteorite impacts [7,8]. As it was shown by [8] for the time ~100 m.y. a significant part of rock boulders which were on the crater rim surface should be destroyed.

Good analog for the described 450-m crater is 650-m crater Camelot at the Apollo 17 landing site [9]. The isotope analysis of samples collected at its rim showed that its age is ~100 m.y. [10]. It is seen on the Apollo 17 and LROC images that the rock boulders associated with this crater are mostly observed in the upper parts of its inner slopes while on the crater rim they form only spatially separated clusters [8].

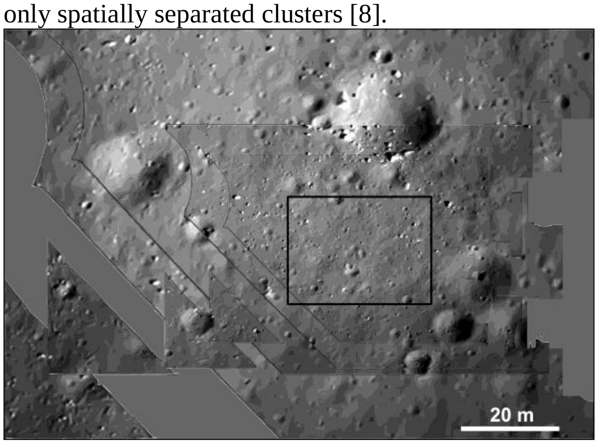

Figure 4. Mosaic of the CE-3 descent camera images. Black box outlines area shown in Figure 5.

Figure 4 shows the CE-3 landing area. It is seen that in the northern part of the shown area there is a crater ~17 m in diameter with shadow on the inner slope of its eastern segment. This means that in morphologic prominence this crater also corresponds to transition from morphologic class AB to class B [2,3]. Based on approach of [3] its age may be estimated as 1-2 m.y. On the rim of this crater are seen a few rock boulders 1.5 to 2.5 m across and about 15 boulders of several decimeters size. They were obviously excavated by the cratering event and because it was very recent most of excavated boulders survived. A few craters of 5 to 15 m in diameters are also seen here. They are morphologically rather prominent that is in agreement with the conclusion on young age of this terrain.

Figure 5 shows details of the close vicinity of the landing site (black circle).

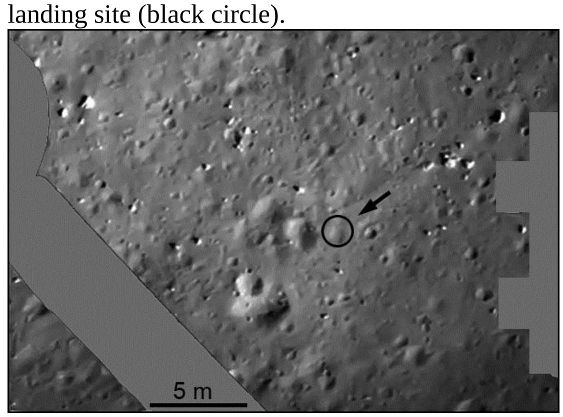

Figure 5. The CE-3 descent image of the landing point

In Figure 5 are seen small (decimeters to 1-2 m) craters and decimeter-size rocks. The latter show no association with craters and are probably remnants of the initial rock-boulder field on the 500 m crater rim.

Summary: The Chang'E-3 landing area is on the rim of young (~100 m.y.) crater of 450 m in diameter which ejected subsurface material from the depth down to ~50 m. Local soil here should be immature.

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References: [1] Florensky C.P. et al. (1972) Space Research XII, 107-121. [2] Florensky C.P. et al. (1972) In: Modern Conceptions on the Moon. Moscow. Nauka press. 20-45 (in Russian). [3] Basilevsky A.T. (1976) Proc. LPSC 7^{th}.1005-1020. [4] Hiesinger H. et al. (2000) J. Geophys. Res. 105. E12. 29,239-29,275. [5] Melosh H.J. (1989) Impact Cratering a Geologic Process. Oxford University Press. 245 p. [6] McKay D.S. (1991) In: Lunar Source Book. Cambridge University Press. 285-356. [7] Horz F.et al. (1975) The Moon. 13, 235–238. [8] Basilevsky A.T. et al. (2013) Planet. Space Sci. 89. 118-126. [9] Muehlberger W.R. et al. (1973) Apollo 17 Prelim. Sci. Report. NASA SP-330, 6-1–6-91. [10] Kirsten T. (1973) Earth Planet. Sci. Lett, 125–130.