correspondence

Lunar farside to be explored by Chang'e-4

To the Editor — The Moon's farside eluded human observation until 4 October 1959, when the Soviet Luna 3 spacecraft flew by. Luna 3 photographed a surface in stark contrast to the lunar nearside; subsequent orbital exploration confirmed that the farside is characterized by thicker crust[1] and far fewer maria (volcanic plains)[2]. Despite this contrast, the 20 landings on the Moon before 2019 were all on the nearside (Fig. 1), because of the difficulty of communication between Earth and the farside. In 2018, a satellite (Queqiao) was successfully deployed to provide the communications relay capability for farside operations by the Chinese Lunar Exploration Program. This enabled the successful farside landing by Chang'e-4 on 3 January 2019, in the Von Kármán crater[3] on the floor of the South Pole-Aitken basin (Fig. 1).

Because the South Pole-Aitken basin, approximately 2,500 km in diameter and 13 km deep (refs. [4,5]), is thought to have formed from an impact that penetrated through the Moon's distinctive plagioclase-rich crust, the basin may expose fragments of the lunar mantle[4–7]. It also contains some of the relatively few farside maria. Therefore, exploration of this region may address some fundamental questions, such as on the nature of the lunar mantle, the cause of the greater crustal thickness on the farside, and how farside maria differ from their nearside counterparts. Furthermore, better constraints of the age of this basin may inform our understanding of the early impact flux on the Moon, and therefore also on Earth.

The Chang'e-4 landing site[3] is located at the eastern edge of the mare-containing Von Kármán crater, within the ejecta field of the nearby Finsen crater. This location was selected to optimize the likelihood of being able to investigate the crustal stratigraphy and regolith development, and to access material from farside maria, the deep crust, and possibly the mantle. Chang'e-4 and its rover, Yutu-2, carry a landing camera, a terrain camera, a panoramic camera, a visible and near-infrared imaging spectrometer, and ground-penetrating radar[8]. These instruments will enable analysis of the topography, regolith, shallow structure and rock and mineral compositions of the landing and roving sites. This information will be valuable for future farside missions, such as ones aiming to return samples. Preliminary analysis of in situ data from the first two lunar days reveals the morphological characteristics (Fig. 2) and underground structure of the landing site. The boundary between impact ejecta and underlying basalt is clearly identifiable, and there is potential evidence of excavated deep mafic material, which could reveal the mineralogy of the lunar mantle.

Chang'e-4 will also investigate the potential of the lunar farside as a platform for astronomical observations[9], using a low-frequency radio spectrometer[8]. The Moon has only a thin ionosphere, so radio-frequency measurements down to 500 kHz are possible at the surface during the day, and at even lower frequencies at night[10]. The farside is shielded from radio interference from Earth, as well as from solar emissions during the lunar night[10], so it is expected to be an excellent location for low-frequency radio astronomy.

The scientific achievements of the Chang'e-4 mission will advance our understanding of both the Moon and the wider solar system. ❐

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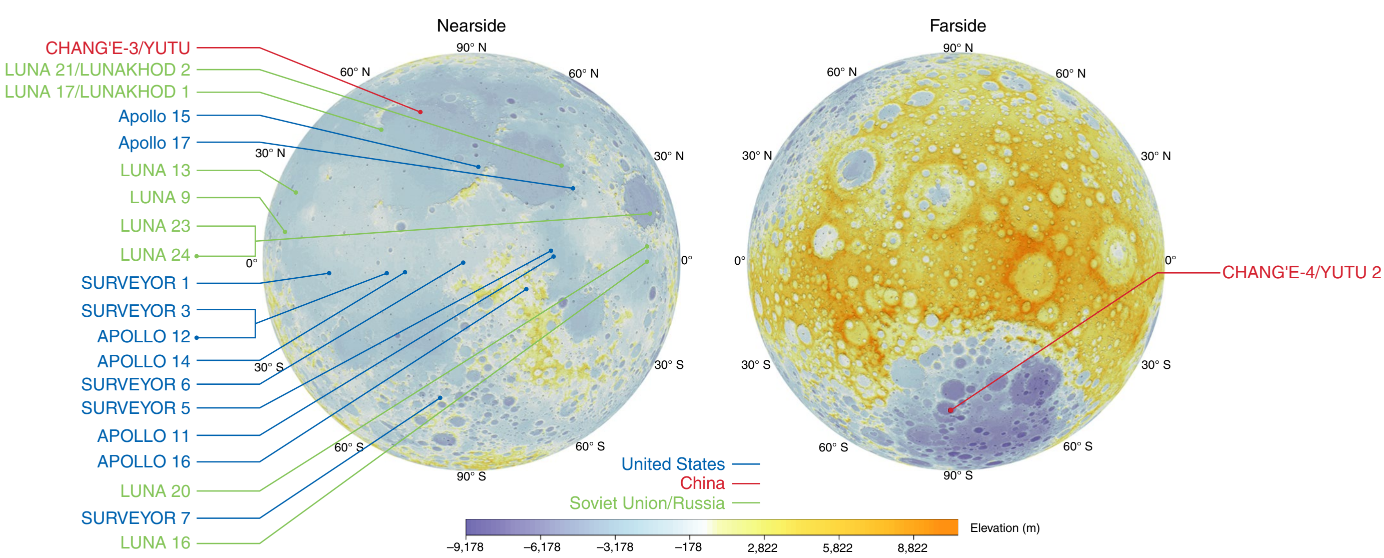

Fig. 1 | Distribution of manned and unmanned landings on the Moon to date. Data (https://go.nature.com/2tT27ez) laid over a digital elevation model from Chang'e-2. China's Chang'e-4 is the first lander on the lunar farside.

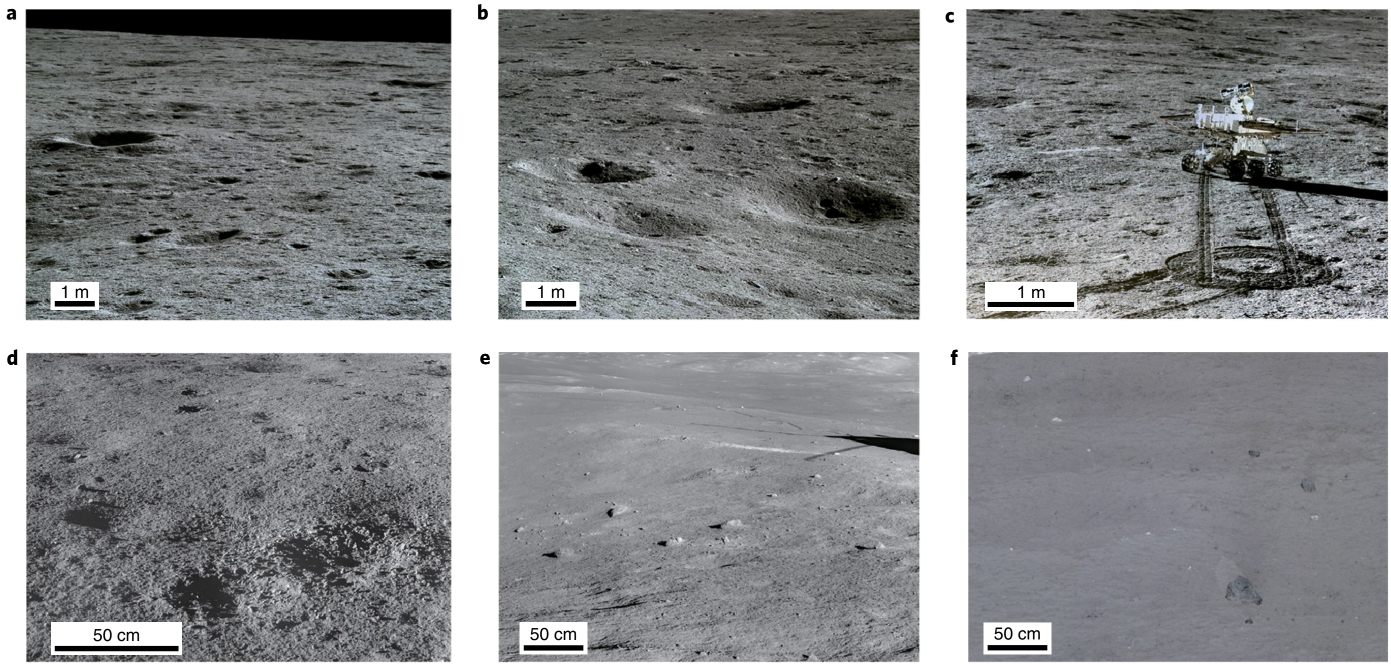

Fig. 2 | Landing-site images taken by the Chang'e-4 lander terrain camera and Yutu-2 panoramic camera. a,**b**, Images of small craters around the landing site. **c**, Rover Yutu-2 exploring the surface. **d**, Close-up view showing rock debris in small craters (from Yutu-2). **e**, Small rocks near the traverse area (from Yutu-2). **f**, Unusually dark rocks near the landing site.

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