

ANALOGUE RESEARCH IN CHINA'S LUNAR EXPLORATION. S. M. Xiang¹ and D. H. Huang^{1,2} ¹Faculty of Earth Science, China University of Geosciences (Wuhan). ²Research Center for Space Science & Technology, China University of Geosciences (Wuhan), Hubei, CHINA 430074. hdhua@cug.edu.cn. +86 027 67884711

Introduction: Although we have sent hundreds of explorer to Lunar, the Lunar surface is still a strange world that we are far away from understanding it. Before exploring the Lunar surface, if we don't perform terrestrial analogue research missions we would encounter much unexpected situation. Analogue research missions can help improving our knowledge about Lunar environment, cutting the exploration risk down and ensuring the goals and objectives be effectively achieved. China's Lunar exploration mission will sent a Lunar rover soft landing on the Lunar surface soon, and the analogue research is necessary. Choosing Eastern Xinjiang Gobi Desert as our Lunar exploration analogue field, after more than three years' investigation, we found are some similar to Lunar, there is almost none life here. Indeed, we can't expect that here is much closed to Lunar surface environment, but we wanted to simulate factors that influence Lunar surface exploring heavily. Comparing with the latest research in other Lunar surface analogue fields all over the world, especially the Atacama Desert in Chile, we believe that Eastern Xinjiang Gobi is an ideal natural terrestrial analogue laboratory for Lunar surface exploration.

Ideological and methodology: There are three phases of Chang'E Program, such as orbiting the Lunar, soft-landing on the Lunar, and sample return from the Lunar [1]. On November 27, 2007, Chinese government published the first image returned from the Lunar by the Chang'E-1. This image (Fig. 1) is the first returned from the Lunar by Chang'E-1. The second and the third phases should be continued following the accomplishment of the first phase.

Although human has been to the Lunar about 35 years ago, we are far from adequately understand the

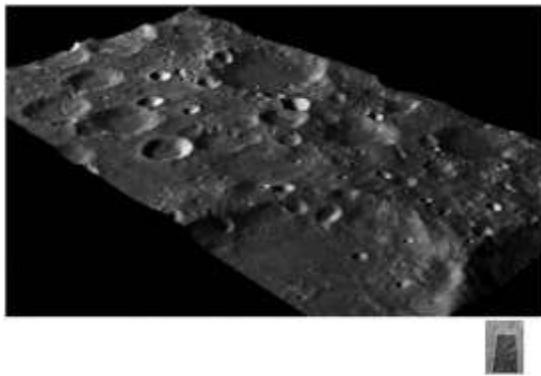


Fig.1. The first 3D topography of the Lunar surface, obtained by Chang'E-1 Lunar orbiter. Credit/CLEP

Lunar surface environment. We must perform terrestrial analogue research mission, so we can cut the risk down of Lunar surface exploration and ensure the goals and objectives will be effectively achieved. Terrestrial analogue research also can help us to answer what can the Lunar rover do on the Lunar surface, how will it accomplishes this, what tools are required for the tasks, what problems it would encounter, how could it do when in trouble? It is very important for the Lunar rover self-awareness in the extreme and isolated environment.

Our idea is "Virtual Reality Combining Analogue Research", which means the 3D simulation of Lunar surface exploring on computer combining with the Lunar explore facility, method, and process tests in the terrestrial analogue field. In the past few years, we focused on the latter.

Extreme Environment in Eastern Xinjiang Gobi: China's Northwest contains some of the oldest, driest, and most isolated deserts on Earth [2]. Within the region, desert pavement occurs on the periphery of hyperarid basins and flanks most major mountain ranges, Eastern Xinjiang Gobi is just a most representative area. This area's ecological environment condition is extreme atrocious: 1) extremely dry, mean annual precipitation is range about 15-25mm, but mean annual vaporization is as much as 2000mm. 2) such a striking temperature cycling. Day temperature cycling is ranged more than 20°C. The highest temperature is 47°C which occurs in summer, and lowest temperature -23°C occurs in winter. 3) Surface covered by desert pavement and poor soil mixture. There are few advanced plants or animals.

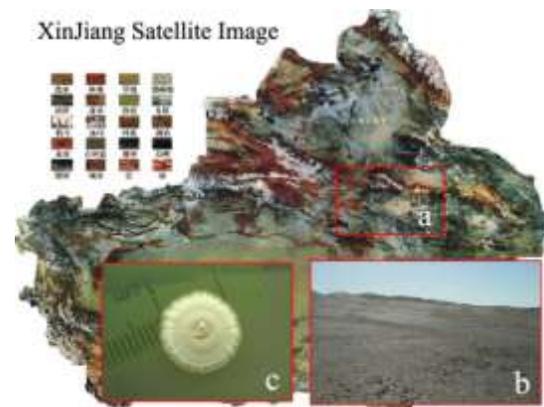


Fig.2. Xinjiang Satellite Image. a) Terrestrial Analogue Field Location; b) Terrestrial Analogue Field View; c) a strain of bacteria that we found.

Tab. 1. The surface environment among Lunar, Eastern Xinjiang Gobi and Atacama Desert

| Area EnvironmentFactor | Lunar | Earth | |
|---------------------------|----------------------|--|---|
| | | Eastern Xinjiang Gobi | Atacama Desert |
| Radiation | Extreme, lethal | Strong | Strong |
| Micrometeorites | Extreme, lethal | none | none |
| Temperature | -155~100°C | -23~47°C | 18°C (summer) |
| Temperature Cycling | Extreme (Day: 255°C) | Strong (Day: ~20°C; Season: 70°C) | Not mentioned |
| Surface Materials | Igneous | shattered Igneous rock and poor soil mixture | shattered rocks, hard-packed soil, and soft sands |
| Atmospheric Pressure | No | Yes | Yes |
| precipitation | Never | Little (MAP 15-25mm) | Almost none in local |
| Gravity (g) | 0.17 | 1 | 1 |
| Mean Solar Day | 29.53 d | 24 h | 24 h |
| Life | No | Very low abundance | lifeless |

Our terrestrial analogue Research has at least three phases : I) 2005-2006, from preliminary surveys, we chose Eastern Xinjiang Gobi as our first terrestrial analogue research field. Combine field investigation and laboratory analysis & processing, we survey the situation and reason of the study area's desertification; furthermore we found three strains of bacteria in a low abundance (Fig. 2). We believe this area is a natural laboratory for Lunar surface environment analogue research. II) 2008-2009, we re-investigation this area, Our goal is to determine the environmental influence on low-grade life' s abundance and diversity; make genuine discoveries about life in extreme environments that can be applied to future Lunar and Mars missions; and test how to close simulate the Lunar surface environment. III) 2009~, combine with the data obtain from Lunar orbiter, we will test the facilities, method which will used in the further Lunar and other planetary surface mission.

Surface Environment Compare: Eastern Xinjiang Gobi, Atacama Desert and Lunar: Besides the Eastern Xinjiang Gobi, many other terrestrial fields performed analogue research all over the world. Across Arctic to Antarctic, from Rio Tinto river of Spanish to Atacama Desert of Chile, multidisciplinary scientists choose a profile enter into the terrestrial analogue research. We considered many different environment factors and suggested that Atacama Desert is also a fantabulous area (Tab. 1). Life in Atacama Desert is actually an astrobiologic and robotic field investigation mission.

Different factor effect on different activities and few factors play a most important role, for Lunar surface rover exploration, surface rock and soil, temperature cycling, mean solar day, radiation & micrometeorites etc. play a predominant role.

Conclusion:Eastern Xinjiang Gobi is an ideal terrestrial analogue field for Lunar surface exploration, we could test our exploration objectives, facilities, methods and processes here at a lower cost. China's

Lunar exploration would benefit in cutting the exploration risk, increasing exploration productivity, ensuring the goals and objectives are effectively achieved, and moreover, it can sustain public interest. If we will plan to transplant life in the future Lunar or even Mars Base, we could take these low-grade microbes as candidated pathbreakers in account.

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