QAIDAM BASIN, NE TIBETAN PLATEAU: A NEW UNIQUE MARS ANALOGUE SITE FOR ITS WET PAST AND DRY ENVIRONEMNT TODAY L. Xiao[1, 2]. J. Wang[1], Y.N. Dang[2], Z.Y.Cheng[1], T. Huang[1], J.N. Zhao[1], J. Huang[1], Y. Xu[2], Z.Y. Xiao[1]. 1. Planetary Science Institute, China University of Geosciences, Wuhan, 430074, P. R. China; 2. Space Science Institute, Macau University of Science and Technology, Macau, China. (longxiao@cug.edu.cn)

1. Introduction

Qaidam Basin is the highest, and one of the driest and largest deserts on Earth. It features with extremely low precipitation, high evaporation; various aeolian geomorphologies. In addition, high UV radiation, variety of saline lakes and evaporates in the region make it a candidate base for astrobiology study. Several studies focusing on evaporate sediments and mineralogy have suggested that the Qaidam basin is potentially a promising Mars analog site [1-6]. This study reports major geomorphological features, distinctive evaporate sediments, evolutionary saline lakes, playas, microbial features in Qaidam Basin, and its advantages for Mars exploration simulation test, which are distinct with other analog sites on Earth and should be listed as a new Mars analog site.

2. Methodology

Field survey and interpretation of satellite images were applied to investigate the various landforms in Qaidam Basin. Sampling and microbia isolation from brine water and evaporate sediments were conducted. CTX, HRSC and HiRISE imagery data were applied to study aeolian- and fluid-related geomorphologic features on Mars.

3. Results

Varity of Mars-like geomorphologies well preserved within the Qaidam Basin. The typical ones are aeolian and evaporation desert landforms and vast areas of salt lakes.

In the Qaidam Basin, dunes are morphologically classified as barchans dunes, barchans dune chains, linear dunes and star dunes, similar in shape and size with its counterparts on Mars (Fig. 1). The yardangs within the basin cover an area of ~20,000 km^2, make it the largest yardang region in China. These yardangs are mostly located in the northwest part of the Qaidam Basin, and wind is the dominate force for their formation. These yardangs show different sizes and shapes, such as mesa, zigzag-like, remnant cone-like, ark-shape, capsized boat-shape, and whale back-like yardangs (Fig. 1).

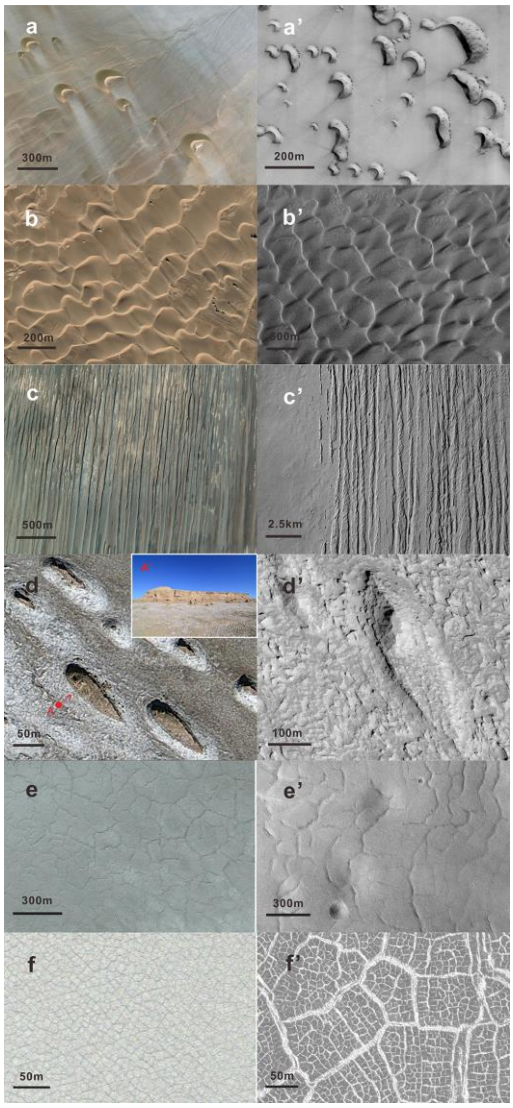

Fig. 1. Dunes (a, b), yardangs (c, d) and polygons (e, f) in Qaidam Basin; a', b', c', d' and e' are their analogues on Mars.

Polygonal surface structures (PSSs) are wide spread surface phenomenon in the Qaidam basin. They are mainly distributed inside the six playas within the basin, namely the Dalangtan, Qahansilatu, Kunteyi, Mahai, Yiliping and Qarhan playas. Generally, these PSSs can

be divided into three distinct types according to their size. The small -sized PSSs are commonly less than 10 m in diameter and mainly display as triangle, quadrangle, and hexagon in planar morphology. Middle-sized PSSs (10-100 m diameter) in the Qaidam basin exhibit various appearances, and many of which are with quasi-polygonal pattern. The largest-sized PSSs (100-300m) are distributed in the Dalangtan playa, and the edges of polygons are ridges that are ~ 4 to 6 m wide. Smaller PSSs occur within the largest PSS.

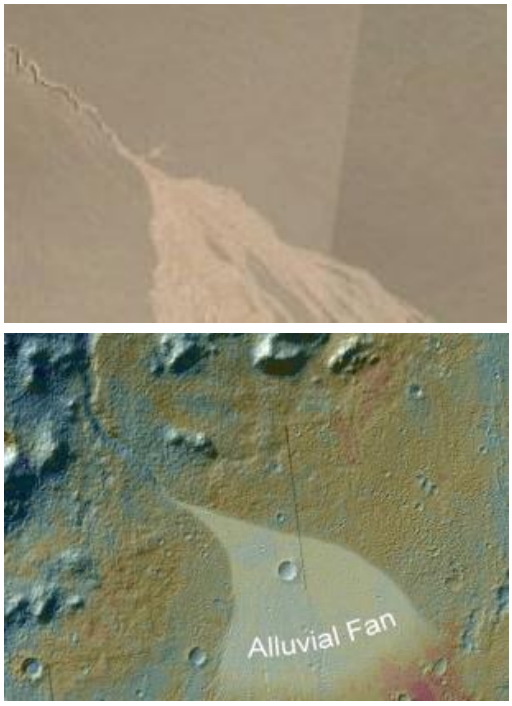

Fig. 2. Alluvial fans in Qaidam Basin (upper) and in Gale crater on Mars (lower).

There are 30 lakes in the modern Qaidam Basin, including 1 fresh lake, 6 brackish lakes, 1 salt lake and 22 brine lakes. Quaternary evaporate deposits are well developed in the six playas. However, they were formed in different time and had distinct physic-chemical evolution history.

Valleys of different scales are widely distributed in the Qaidam Basin, especially in the marginal area of the basin. Most of them originated from the surrounding mountains and formed by glacial meltwater and occasional rainfall (Fig. 2). Gullies in the Qaidam Basin can be tens to hundreds of meters long and usually form on hillsides during or after heavy rains. However, light rain or small water flow can also develop gully when it run through loose sands.

Lipid molecules have been found in saline lakes, and salinity is the main factors influencing the microbial community. Our study suggests that archaeal lipids dominate in units with high salinity, whereas bacterial lipids dominant in detrital units with low-salinity. Twenty three species of bacteria and eight species of fungi were identified from the deposits.

4. Discussion and concluding remarks

Qaidam basin is the highest and one of the largest and driest desert on Earth. It is located at a dry, cold, high UV environment, similar as the surface of Mars.

Variety of aeolian landforms are widely spread in the desert regions of the Qaidam Baisn. Most of dunes and yardangs types have their counterparts on Mars. Detailed study about the origin and evolution of the dunes and yardangs could provide clues on understanding how wind has operated and/or is operating on Mars. Precipitation in Qaidam Basin is very low, the valleys gullies and fluvial fans are distributed along the surrounding hillsides. The 30 salt lakes and playas represent different stages of lake evolution. It provides unique examples to study how fresh water lakes became hypersaline lakes, and finally to playas. This could provide clues on understanding past martian environmental changes. As different evaporate mineral assemblages have been identified in the playas within Qaidam Basin, the origin of their counterparts on Mars could be inferred. Microbial systems are developed in the salt lakes and playas with various species, although no visible life signatures have been recognized in most of the playas and hypersaline lakes.

The variety of epigenetic and endogenetic geomorphic type, sedimentary rocks, salt lakes, evaporite mineral assemblages and Mars-like extreme environment collectively make the Qaidam Basin as a new and unique Mars analogue site on Earth, for both of scientific research and mission test.

References: [1] Mayer et al. (2009). LPSC, XL abstract #1877 [2] Wang and Zheng, (2009). LPSC XL, abstract #1402. [3] Zheng et al. (2009). LPSC XL Abstract #1454. [4] Zheng et al., 2013. Acta Geologica Sinica, 87(3):885-897. [5]Kong et al. (2013). 44th LPSC, #1719. [6] Kong et al., 2014. American Mineralogist, 99, 283-290.