THE QAIDAM BASIN IN NORTH TIBET, A MARTIAN ANALOGUE. APPLICATIONS FOR LANDING SITES OF MARS MISSIONS. A. Anglés[1], [1]The University of Hong Kong, Department of Earth Sciences, Pok Fu Lam Road, Hong Kong (aangles@connect.hku.hk).

Introduction: Early Mars was characterized by wetter and warmer environments, until a significant climatic and hydrologic shift irreversibly led to the current hyper-arid environments. This transition is one of the most intriguing processes of Martian history. The extreme climatic change is preserved in the salt deposits, desiccated landscapes and geomorphological structures that were shaped by the losing of water. However, until a manned journey to Mars is feasible, many Martian materials, morphological structures, and much of its evolutionary history will continue to be poorly understood. In this regard, searching and investigating Martian analogues is still meaningful. To find an Earth environment with a whole set of Martian structures distributed at a scale comparable to Mars is even more important to test landing crafts and provide optimized working parameters for rovers.

The western Qaidam Basin in North Tibetan Plateau is such a Martian analogue. The area harbors one of the most extreme hyper-arid environments on Earth, and contains a series of ancient lakes that evaporated at different evolutionary stages during the rise of the Tibetan Plateau. Large quantities of salts and geomorphological features formed during the transition of warmer/wetter to colder/drier conditions provide unique references to study the Martian surface and interpret the orbital data. Plentiful similarities and results of investigations during expeditions confirm the Qaidam Basin is one of the best analogues to study the evolutionary history of Mars, and suggest that this is an essential site to test future Mars sample return missions.

The Qaidam Basin: The Qaidam Basin lies in the north of Tibetan Plateau (Fig. 1) [1], measuring roughly 850 km from east to west and 150-300 km from north to south [2], covering a total area of 120,000 km^2 and a catchment area of 250,000 km^2 [3].

Formed from the drying up of sulfate brines in a giant lake, the Qaidam Basin is the highest desert on Earth and the largest sedimentary basin in the Tibetan Plateau, offering a gigantic laboratory to compare Martian climatic processes, geological landforms and potential records of Martian microbial life. The detection of Ring Structures that imply tectonism on both the Qaidam Basin and Mars or the findings of biomarkers on carbonates in the Qaidam Basin are of key importance in Astrobiology.

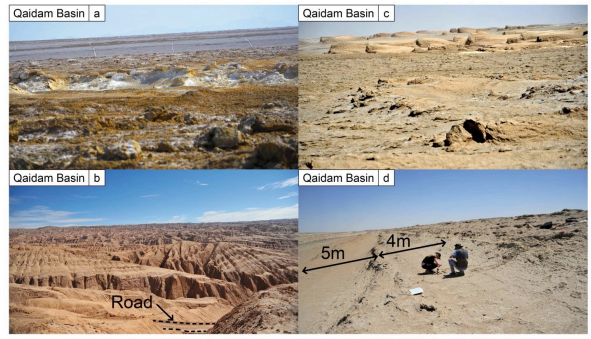

Figure 1. A few selected typical morphologies of the Qaidam Basin. a: Picture taken near the playa area of Xiaoliang Mountain, where the very weak hydrodynamic processes have eroded the surface. Note the track traces in the back of the picture for scale. b: Mountain area in western Qaidam Basin near 38.10°N, 91.05°E. Note the road for scale. c: Yardangs near Nanyi Mountain in the distance and salt and clay mixed playa. The yardangs are approximately 10 m high. d: Image taken in the south part of Nanyi Mountain at 38.10°N, 91.75°E, at 2796 m of altitude.

Conclusions: Mineralogical compositional analyses from SEM and XRD of the Qaidam Basin confirm that the depositional materials are rich in sulfate, followed by halite and clay minerals. There are a variety of clays together with chlorides, attesting to an important role of past water. The results suggest saturated sulfate solutions and precipitation resulting from evaporation of brines, which is of great interest for Mars mineralogy as magnesium sulfates, calcium sulfates and polyhydrate sulfates have been detected at many Martian locations. Large deposits of gypsum and halite that form the saline lakes deposits in the Qaidam Basin are comparable to those sulfate deposits detected on the Martian surface. The TG analysis gives us important information on the amount of water molecules in pure gypsum samples; 20% of water is contained in the crystals and this has a direct implication to the gypsum deposits on Mars.

The adaptive mechanisms of hypolithic organisms to survive the environmental extremes in the Qaidam Basin can also contribute to an understanding of extremophiles and it is directly relevant to any possible life on Mars. The immense size of the Qaidam Basin is also of great importance for future Mars exploration programs. Rovers can explore their capabilities and drive in real-time with extreme hyper-arid conditions.

The practice of sample acquisition, detection of obstacles and movement though abrupt surfaces will provide valuable parameters for the exploration of future targets on Mars. The Qaidam Basin is a realistic environment that replicates the distribution of features and materials that the vehicles will find on the Martian surface.

While the processes and resulting geomorphological landforms on the Qaidam Basin provide a feasible analogue to the Martian topography and its structures, it is recognized that the exact Martian conditions are not characterized. Nevertheless, given the similarities that the Qaidam Basin contains, especially around the climate, aridity and hydrology, this area may be one of the most valuable terrestrial analogues to study the Martian processes, landforms and microorganism preservation potential, and can be treated as an important site for confirming future Mars sample return missions.

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