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Qaidam Basin, NE Tibetan Plateau: A new Mars analogue site

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A variety of Mars-like landforms are well preserved within the Qaidam Basin, NE Tibetan Plateau. The typical ones are aeolian and evaporation desert landscapes (e.g. dunes, yardangs, salt polygons, playas) and vast areas of salt lakes. In the Qaidam Basin, dunes are morphologically classified as barchan dunes, barchan dune chains, linear dunes and star dunes, similar in shape and size with its counterparts on Mars. The yardangs within the basin cover an area of ~20,000 km², 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.

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, Chahansilatu, 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 (100-300 m) are distributed in the Dalangtan playa, and the edges of polygons are fissures that are ~ 4 to 6 m wide. Smaller PSSs occur within the largest PSS.

Qaidam Basin is the highest and one of the largest and driest deserts on Earth. It is located in a dry, cold, high UV environment, similar as the surface of Mars. A variety of aeolian landforms are widely spread in the desert regions of the Qaidam Basin. Most of the dune and yardang 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. 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 macro-scaled life signatures have been recognized in most of the playas and hypersaline lakes.

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

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