

GEOLOGIC CHARACTERISTICS OF YARDANGS ON MARS AND THEIR IMPLICATIONS FOR PALEO-ENVIRONMENTS: CONSTRAINTS FROM COMPARISON BETWEEN THE QAIDAM BASIN/CHINA AND THE AEOLIS-ZEPHYRIA REGION. Jiang Wang¹, Long Xiao^{1,2}, Dennis Reiss³, Harald Hiesiger³, Jun Huang¹, Yi Xu², Jiannan Zhao¹, Zhiyong Xiao¹ and Goro Komatsu⁴. ¹Planetary Science Institute, School of Earth Sciences, China University of Geosciences, 430074 Wuhan, China (j.wang@cug.edu.cn), ²Space Science Institute, Lunar and Planetary Science Laboratory, Macau University of Science and Technology, Taipa, Macau, China, ³Institut für Planetologie, Westfälische Wilhelms-Universität, Münster, Germany, ⁴International Research School of Planetary Sciences, Università d'Annunzio, Pescara, Italy.

Introduction: Wind-eroded ridges known as yardangs are common in most arid desert regions on Earth. They also have been identified on Venus, Titan, and Mars [1-2]. Among those on Mars, various yardangs exist especially in the Aeolis-Zephyria Planum (AZP) region, west of the Medusae Fossae Formation (MFF). Previous investigations have studied their types, distribution, and formation [3-5]. However, the limited coverage of high-resolution images of Mars has constrained their research areas and quantitative studies. To fully understand the formation mechanism and evolution histories of MFF yardangs, further studies on terrestrial analogues are useful. Featuring various comparable Mars-like yardangs, ones in the Qaidam Basin might shed light on the geological history of Mars [6-9].

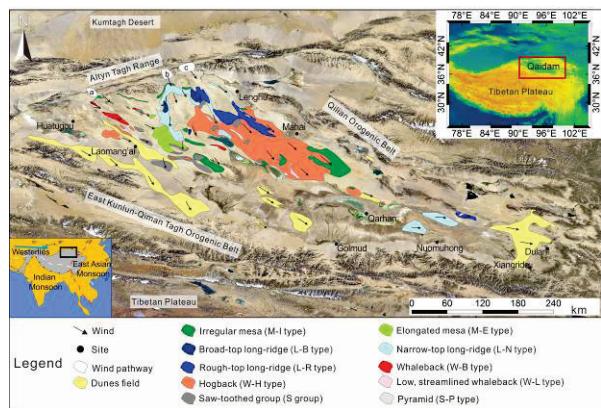


Figure 1. The Qaidam Basin and distributions of different yardang types [8-9].

Yardangs in the Qaidam Basin: The Qaidam Basin is the largest yardang field in China. Most of the yardangs are distributed in the northwestern and central eastern parts, with dominant orientations from NW to NNE and approximately W-E, respectively (Fig. 1). Based on their morphologies and distributions, yardangs within the Qaidam Basin have been classified into 11 different types and four main groups (mesa group (M group), long-ridge group (L group), saw-toothed group (S group), and whaleback group (W group)). The average aspect ratios for the mesa and whaleback group yardangs are nearly 3:1, while those

for most of the long-ridge group yardangs are greater than 5:1 (Fig. 2). The heights of yardangs exhibit obvious differences depending on types and regions. Most of their heights are below 20 m, with an average value of 6.42 m (Fig. 3). Based on former studies [10-12] and our work [6-9], we proposed a four-step (embryonic, adolescent, mature, and receding) evolution model to describe the yardang formation and degradation in the Qaidam Basin (Fig. 4).

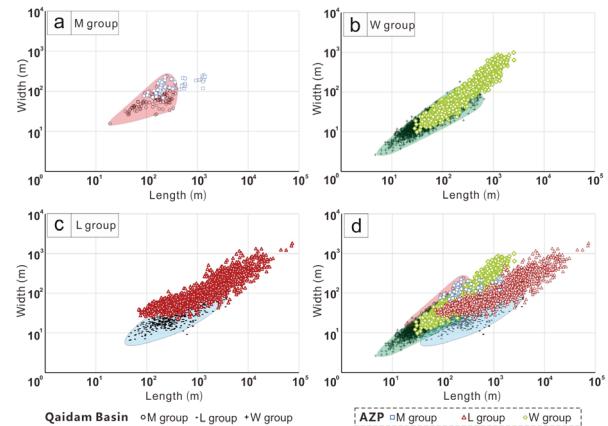


Figure 2. The log-log plots of lengths versus widths of yardangs both in the Qaidam Basin on Earth and in the AZP region on Mars. Red, green, and blue areas are the M, L, and W group yardangs in the Qaidam Basin, respectively [9].

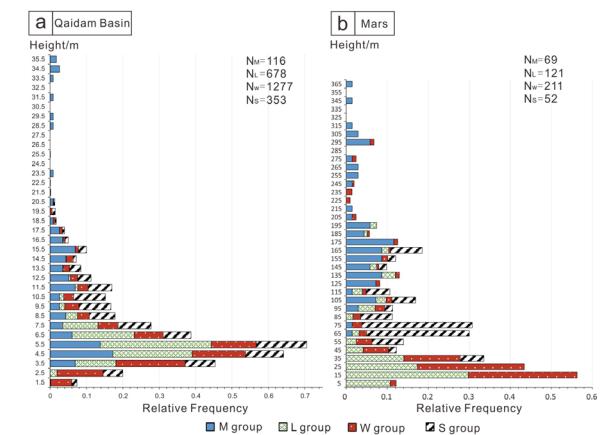


Figure 3. The heights of different yardangs both in the Qaidam Basin on Earth and in the AZP region on Mars [9].

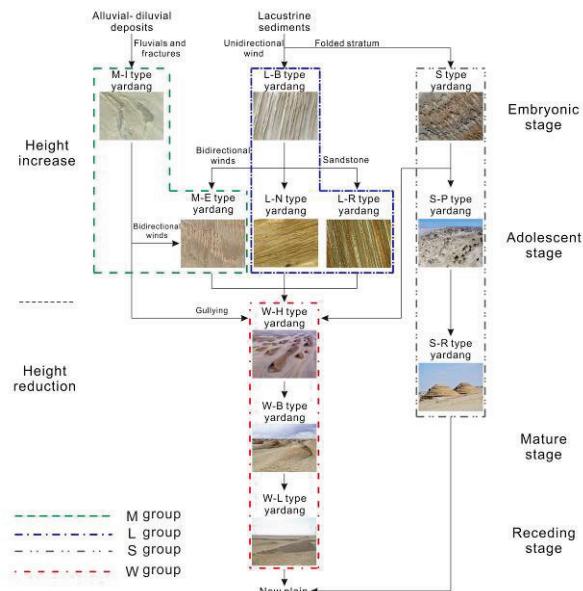


Figure 4. The evolution model for yardangs in the Qaidam Basin [8-9].

MFF yardangs in the AZP region: The total area covered by of yardangs in the AZP region is $\sim 3.67 \times 10^5$ km 2 , most of which is distributed in the Aeolis Planum, Zephyria Planum and the AZP central basin (Fig. 5). We have identified 10 types of yardangs in the AZP region and sorted them into four main groups, using the same criteria as for those in the Qaidam Basin. Morphologically, the mean aspect ratio for the whaleback group yardangs is about 3:1, with over 98% of them less than 5:1. While for the long-ridge group yardangs, over 81% of them are greater than 5:1 (Fig. 2). The mean height of yardangs in AZP is about ~ 73 m, and over 72.5% of them are less than 100 m (Fig. 3). The orientations of yardangs in the Aeolis Planum and the AZP central basin are NW-SE and S-N near the highland, while in the Zephyria Planum, the major orientations are S-N, W-E, NE-SW, and SE-NW.

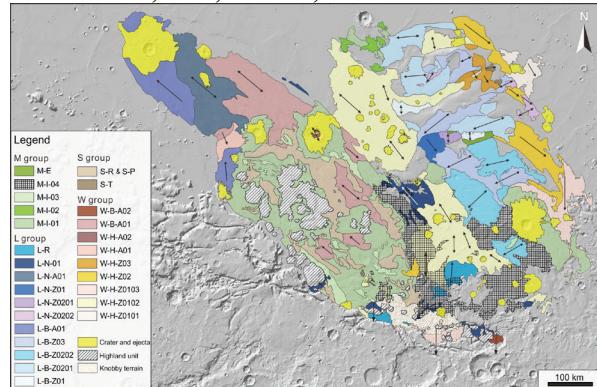


Figure 5. The AZP region and distributions of different yardang types [9]. Black arrows mark the orientations of yardangs.

Based on their similarities in morphologic and geometric characteristics of the yardangs both in the Qaidam Basin on Earth and in the AZP region on Mars (Fig. 2), the MFF yardangs may have experienced similar multi-stage evolution processes. However, we have not found a full continuous four-stage evolution sequence occurring in one area in the AZP region. We must note that the evolution processes may have been interrupted at some stages due to differences in the competence of rocks and/or changes of the environment, for example, abrupt climate changes or infilling of sediments. According to the relationships among yardangs of different types and layers, the formation of the MFF material is discontinuous, and MFF yardangs formed intermittently. The accumulation of MFF materials in the AZP region experienced at least four breaks and the prevailing wind regime has changed dramatically at least four times.

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