

Effects of Surface Weathering on the Development of Yardang Landforms in the Loulan Area: Postprint

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Abstract

Wind erosion is the primary controlling factor in the development of yardang landforms, but in specific environments, other environmental factors may also play important roles. This study investigates the influence of weathering on yardang development through field surveys, testing, and laboratory experimental analysis of yardang landforms in the Loulan area. The results reveal that yardang landforms are extensively developed in the Lop Nur region of Xinjiang, with those in the Loulan area being relatively small in stature, primarily developed on Holocene sedimentary rocks, lacking any cover of vegetation or loose sediments on the surface, with exposed stratigraphy. The Loulan yardang bodies consist of clayey siltstone, which is relatively hard under dry conditions ($>20 \text{ Kg} \cdot \text{cm}^{-2}$) and possesses strong wind erosion resistance; however, the surface lithology of the yardang bodies undergoes significant softening ($<10 \text{ Kg} \cdot \text{cm}^{-2}$). This is primarily caused by the interaction of several factors in the Lop Nur region: although rainfall is extremely scarce, the small amount of concentrated precipitation, atmospheric moisture condensation resulting from surface diurnal temperature variations, and intense solar radiation. The widespread presence of these soft layers indicates that the weathering rate of yardang bodies exceeds that of wind erosion, and the initial surface weathering process significantly promotes wind erosion of the yardangs, markedly accelerating the development of yardang landforms in the Loulan area. Therefore, weathering processes influenced by minimal precipitation, diurnal temperature variations, and intense solar radiation exert a significant influence on the development of yardang landforms in the Loulan area.

Full Text

Preamble

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Weathering Impact on the Development of Yardang Landforms in the Loulan Region

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Abstract

Wind erosion is the key controlling factor for Yardang landform development; however, other factors may also play important roles under certain conditions. This paper analyzes the potential influence of weathering on Yardang development based on field investigations and laboratory experiments. The results indicate that multiple types of Yardang landforms exist in the Lop Nur region of Xinjiang, China. In the Loulan area, Yardang landforms lacking vegetation cover are relatively short and small, having developed on sedimentary rocks formed primarily during the Holocene. The clayey siltstone strata of these Yardangs are hard under dry conditions ($>20 \text{ kg} \cdot \text{cm}^{-2}$) and strongly resistant to wind erosion. However, the top layers ($\sim 15 \text{ cm}$) of the clayey siltstone are often significantly softer ($<10 \text{ kg} \cdot \text{cm}^{-2}$). This softening is mainly caused by the combined effects of low-volume but concentrated rainfall, moisture condensation from diurnal temperature variations, and intense solar radiation. The softening of the surface clayey siltstone indicates that weathering on Yardang surfaces proceeds significantly faster than wind erosion. Initial weathering of Yardang landforms promotes subsequent wind erosion and accelerates Yardang development in the Loulan region. Therefore, weathering exerts a direct and important influence on Yardang landform development in the study area.

Keywords: Yardang; weathering; wind erosion; Lop Nur

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