Red Beds and Their Geological Hazards: Post-print

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Abstract

Red beds represent a general term for red rock series deposited throughout various geological historical periods, constituting typical "slip-prone strata" that are susceptible to clustered geological hazards during heavy rainfall events. Based on a synthesis of research findings on the development, distribution, and main characteristics of red beds both at home and abroad, findings indicate that the properties of red beds are controlled by sedimentary formation, and the physico-mechanical and hydraulic properties of red bed rocks are closely related to their sedimentary environment. Red bed rocks are characterized by strong rheological behavior and pronounced hydrophilicity, and are prone to swelling, disintegration, argillization, and softening when encountering water. This study analyzes and summarizes the main types of geological hazards in red bed areas, with particular emphasis on the formation mechanisms of translational landslides in interbedded sandstone-mudstone regions and gentle shallow soil landslides. The results indicate that hydrostatic pressure generated by rapid infiltration of rainwater into vertical fractures in sandstone during rainfall constitutes the main driving force for translational landslides, while the long-term argillization and water-saturated softening of the sandstone-mudstone contact interface or weak interlayers by groundwater substantially reduces the strength of the basal slip surface, representing another primary cause for large-scale translational landslides. Additionally, the special slope hydrogeological conditions formed by the unique lithological combination of sandstone-mudstone interbeds represent another critical factor for landslide susceptibility. The existence of atmospheric influence depth within slope residual deposits and interface effects at the bedrock-cover interface in gentle red bed regions constitute the primary causes of clustered shallow soil landslides during heavy rainfall, which additionally determine the thickness of the sliding mass. Finally, this paper discusses risk prevention and control measures for geological hazards in red beds, suggesting that the establishment of physical early warning models through mathematical and mechanical analysis combined with field observations and laboratory testing

constitutes an effective approach for red bed landslide early warning. Furthermore, landslide mitigation in red bed areas should adhere to the principle of drainage-oriented measures supplemented by anti-slide retaining structures.

Full Text

Study on Red Beds and its Geological Hazards

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Abstract

Red beds, defined as the collective term for red-colored rock series deposited during various geological periods, represent typical "slide-prone strata" that are highly susceptible to clustered geological hazards during intense rainfall events. A comprehensive review of domestic and international research reveals that the engineering properties of red beds are fundamentally controlled by their sedimentary formation, with their physical-mechanical and hydro-physical characteristics being intimately linked to the depositional environment.

These rocks exhibit pronounced rheological behavior and strong hydrophilicity, readily undergoing expansion, disintegration, argillization, and softening upon water exposure. This study systematically analyzes and summarizes the primary types of geological hazards in red bed regions, with particular emphasis on the formation mechanisms of translational landslides in sandstone-mudstone interbedded areas and gentle shallow soil landslides on low-angle slopes.

For translational landslides, hydrostatic pressure generated by rapid infiltration of rainfall into vertical fractures within sandstone layers serves as the principal driving force. Simultaneously, long-term argillization and saturation-induced softening of sandstone-mudstone contact interfaces or weak interlayers substantially reduce the shear strength along basal sliding surfaces, constituting another critical factor for large-scale translational failures. Furthermore, the unique hydrogeological conditions arising from the special lithological assemblage of sandstone-mudstone interbeds represent an important predisposing factor for landslide susceptibility.

In gentle red bed terrain, the presence of an atmospheric influence zone within slope residual layers and interface effects at the bedrock-cover boundary are identified as the primary causes of clustered shallow soil landslides during heavy rainfall, which also govern the thickness of failure masses.

Finally, the paper discusses risk prevention and control strategies for red bed geological hazards, proposing that effective early warning can be achieved through establishing physical prediction models based on integrated mathematical-mechanical analysis, field monitoring, and laboratory testing. For landslide mitigation in red bed areas, a treatment philosophy prioritizing drainage measures with supplementary anti-slide support structures is recommended.

Keywords: Slope engineering; Red beds; Geological hazards; Genetic mechanism; Translational landslide; Shallow soil landslide

Note: Figure translations are in progress. See original paper for figures.