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Experimental study of sediment transport processes and size selectivity of eroded sediment on steep Pisha sandstone slopes

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The Pisha sandstone area on the Ordos Plateau of China is the primary source of coarse sediment of the Yellow River. Sediment size distribution and selectivity greatly affect sediment transport and deposition. Hence, sediment transport processes and size selectivity by overland flow on Pisha sandstone slopes were investigated in this study. Experiments were run with Pisha sandstone soil (bulk density of 1.35 g/cm^3) under rainfall intensities of 87 and 133 mm/h with a 25° slope gradient, and the duration of simulated rainfall is 1 h. Sediment and runoff were sampled at 2-min intervals to examine the size distribution change of the eroded sediment. The particle composition, enrichment rate, fractal dimension, and time distribution characteristics of median grain size (d_{50}) of eroded sediment were comprehensively analyzed. Statistical analyses showed that the erosion process of Pisha sandstone slope mainly transported coarse sediment. More than 40% of eroded sediment particles were coarse sediment, which will become the main sediment in the lower reaches of the Yellow River bed. The particle size of eroded sediment tended to gradually decrease with the continuous rainfall but remained larger than the background value of Pisha sandstone soil after refinement. The fractal dimension was positively correlated with the slope flow velocity, while the d_{50} was negatively correlated with the slope flow velocity. Overall, these findings show a strong relationship between the sediment transport and flow velocity, which indicates that the selectivity and transportation of sediment particles on the Pisha sand slopes is mainly influenced by the hydrodynamic parameters of overland flow. This study provides a methodology and data references for studying the particle selectivity characteristics of eroded sediment and provides a scientific basis for revealing the mechanism of erosion and sediment yield in the Pisha sandstone area of China.