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Distribution of rock fragments and their effects on hillslope soil erosion in purple soil, China

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Purple soil is widely distributed in Sichuan Basin and Three Gorges Reservoir Area. Purple soil region is abundant in soil fertility and hydrothermal resources, playing an important role in the agricultural development of China. Soil erosion has long been recognized as a major environmental problem in the purple soil region where the population is large and slope farming is commonly practiced, and rainstorm is numerous. The existence of rock fragments is one of the most important characteristics of purple soil. Rock fragments at the soil surface or in the soil layer affect soil erosion processes by water in various direct and indirect ways, thus the erosion processes of soil containing rock fragments have unique features. Against the severe soil degradation by erosion of purple soil slope, carrying out the research about the characteristics of purple soil containing rock fragments and understanding the influence of rock fragments on soil erosion processes have important significance, which would promote the rational utilization of purple soil slope land resources and accurate prediction of purple soil loss. Therefore, the aims of this study were to investigate the distribution of rock fragments in purple soil slope and the impact of rock fragment content on soil physical properties and soil erosion. First, field sampling methods were used to survey the spatial variability of rock fragments in soil profiles and along slope and the physical properties of soils containing rock fragments. Secondly, indoor simulated rainfall experiments were used to exam the effect of rock fragments in the soil layer on soil erosion processes and the relationships between rainfall infiltration, change of surface flow velocity, surface runoff volume and sediment on one hand, and rock fragment content (Rv, 0%∼30%, which was determined according the results of field investigation for rock fragment distribution) on the other were investigated. Thirdly, systematic analysis about the influence of rock fragment cover on purple soil slope erosion process were carried on, under different conditions with two kind of rock fragment positions (resting on soil surface and embedded into top soil layer), varied rock fragment coverage (Rc, 0%∼40%), two kind of soils with textural porosity or structural porosity, and three kind of rainfall intensities (I, 1 mm/min, 1.5 mm/min and 2 mm/min). Simulated rainfall experiments in situ plots in the field, combined with simulated rainfall experiments in soil pans indoor, were used. The main conclusions of this dissertation are as following:
1. The spatial distribution characteristics of rock fragments in purple soil slope and its effects on the soil physical properties were clarified basically.
2. The mechanism of influence of rock fragments within top soil layer on soil erosion processes was understood and a threshold of rock fragment content on the infiltration was figured out.
3. The relationships between surface rock fragment cover and hillslope soil erosion in purple soil under different conditions with varied rock fragment positions, soil structures and rainfall intensities were obtained and the soil and water conservation function of surface rock fragment cover on reducing soil loss was affirmed.