Detachment of Natural Loess Soil by Shallow Flow

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Soil erosion is one of the most serious environmental issues in Yellow River basin and has closely relationship to sediment transport, river bad raise, flood control, and water resource management in the down stream of Yellow River. It is very significant to understand the basic processes of soil erosion and to develop prediction model to direct the action of soil and water conservation and to reduce soil erosion in this region.

Soil detachment, sediment transport, and deposition are three sub-processes of soil erosion. Quantification of soil detachment rates is necessary to establish a basic understanding of soil erosion processes and to develop fundamental-based erosion models. Many studies have been conducted on the detachment rates of disturbed soils, but very little has been done to quantify the rates of detachment for natural soil conditions. This study was conducted to evaluate the influence of flow discharge, slope gradient, flow velocity, shear stress, stream power, and unit stream power on detachment rates of natural, undisturbed, loess soil. Flow rates ranged from 0.25 to 2.0 l s^{-1} and slope gradient ranged from 8.8% to 46.6%. This study was compared with a previous study that used disturbed soil prepared by static compression. The results indicated that the detachment rates of disturbed soil were 1 to 23 times greater than the ones of natural undisturbed soil. It was necessary to use natural undisturbed soil samples to simulate the detachment process and to evaluate the influence of hydraulic parameter on detachment rate. Along with flow rate increasing, detachment rate increased as a linear function. Detachment rate also increased with slope gradient, but the functional relationship between the two variables depended on flow rate. Stepwise regression analysis indicated that detachment rate could be well predicted by a power function of flow rate and slope gradient (R^2=0.96). Mean flow velocity was closely correlated to detachment rate (r^2=0.91). Flow detachment rate was better correlated to a power function of stream power (r^2=0.95) than to functions of either shear stress or unit stream power.