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Hydrological Response and Flow Pathways in Acrisols on a Forested Hillslope in Monsoonal Sub-tropical Climate, Chonqing, Southwest China

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ABSTRACT

The nature of subsurface flow depends largely on hydraulic conductivity of the vadoze zone, the permeability of the underlying bedrock, the existence of soil layers differing in hydraulic properties and macropore content, soil depth and slope angle. Quantification of flow pathways on forested hillslopes is essential to understand the hydrological dynamics and solute transport patterns. Acrisols, with their argic Bt horizons, are challenging in this respect. To increase the understanding of flow pathways of water and the short-term variability of the soil moisture patterns in Acrisols, a field study was conducted on a forested hillslope in the Tie Shan Ping (TSP) watershed, 25 km northeast of Chongqing city, PR China. This catchment is covered by mixed secondary forest dominated by Masson pine (*Pinus Massoniana*). The soil's K_{sat} reduced significantly at the interface between the AB and Bt horizons (2.6E-05 versus 1.2E-06 m s^{-1}). This led to that the flow volume generated in the Bt horizon was of little quantitative importance compared to that in the AB horizon. There was a marked decrease in porosity between the O/A horizon and the AB horizon, with a further decrease deeper in the mineral subsoil. Especially the content of pores >300 µm were higher in the AB horizon (14.3%) compared to the Bt horizon (6.5%). This explains the difference in K_{sat} values. Our study shows that Bt horizons have limited water transport capability, forcing part of the infiltrated rainwater as interflow through the OA and AB horizons. The topsoil thus responds quickly to rainfall events, causing frequent cycles of saturation and aeration of soil pores,

Keywords: preferential flow, subsurface lateral flow, hydraulic conductivity, hillslope hydrology, dye tracer

INTRODUCTION

The nature of subsurface flow in soils depends largely on the hydraulic conductivity of the vadoze zone, the permeability of the underlying bedrock, existence of soil layers differing in hydraulic properties and macropore content, soil depth and slope angle (Lehmann *et al*., 2007). The ratio of vertical and lateral water transport depends on slope angle and the degree of the anisotropy with respect to hydraulic conductivity (e.g. Zaslavsky and Rogowski, 1969; Ritsema *et al*., 1998; Elsenbeer, 2001). The rate of downhill-directed sub-surface water flow is not only determined by differences in