Japan Geoscience Union Meeting 2014
(28 April - 02 May 2014 at Pacifico YOKOHAMA, Kanagawa, Japan)

AHW07-12 会場:511 時間:4 月 29 日 12:30-12:45

日本の花崗岩山地流域における土層形成速度関数と土層輸送係数: 豪雨による表層崩壊の水文地形学的危険度評価にむけて
Soil production functions and soil layer mobility in Japanese mountainous catchments underlain by granitoid rocks

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Soil-mantled hillslopes cover a major area of mountainous catchments in humid temperate regions. The soil layer on hillslopes is maintained by a balance between soil production and transport especially at hill noses, while the soil accumulated in hollows is eventually removed by a rainfall-induced shallow landslide. The rates of soil production and soil creep pace the growth of soil thickness at a hollow and thus determine the return period of landsliding. The soil layer buffers rainfall infiltration into hillslopes and hence controls subsurface runoff system in a catchment. Hydro-geomorphological evolution of a catchment results from the interaction between long-term soil layer development and short-term rainfall runoff processes. The quantification of soil dynamics on hillslopes is thus critical in understanding present-day hydrological condition of a catchment and for geomorphological landslide hazard mitigation.

The uppermost part of decomposed bedrock (saprolite) gradually disintegrates to form the mobile soil layer, which achieves to a steady-state thickness reflecting sediment budget at a soil column. The saprolite-to-soil conversion rate beneath a soil column decreases with increasing thickness of the soil layer, which is called as soil production function (SPF). Soil particles apart from the saprolite move downslope by soil creep at a rate controlled by slope gradient, biological activity and soil thickness. Evaluation of SPF as well as the soil layer mobility is essential when we simulate soil dynamics on a hillslope. SPF can be determined from concentration of terrestrial cosmogenic nuclides at uppermost part of saprolite, while soil layer mobility can be estimated by soil thickness survey by digging pits on a nose-hollow pair of hillslopes. We present examples of SPFs in Japanese mountainous catchment underlain by granitic rocks, and demonstrate results of simulation of soil development to map potential sites of shallow landslide and to assess volume of sediment that may yield at a catastrophic landslide event by heavy rainfall.

キーワード: 土層形成速度関数, 宇宙線生成核種, 土砂輸送, 表層崩壊, 地形発達
Keywords: soil production function, terrestrial cosmogenic nuclides, sediment transport, shallow landslide, landscape evolution