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Soil depth and topography: a field assessment of evolutionary controls in a small catchment

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Soil depth is the difference between soil production and soil erosion. Given uniform soil properties, soil depth limits the water storage capacity of a soil and therefore controls soil biological productivity. It is generally believed that soil depth varies down a hillslope and according to the catena concept and is shallow at the hillslope crest and deepest at the footslope. However, soil depth is a notoriously difficult hillslope feature to quantify. Globally there is a paucity of catchment scale soil depth data. Here soil depth was measured in a small 7.5 ha catchment (Stanley Jr) with basalt derived soils in south-eastern Australia. Depth was measured at regular 25m spacings using a petrol-powered auger to point of refusal. A Global Positioning Unit (GPS) was used to locate coordinates for each measurement. Soil depth was found to be shallower at the top of the catchment and increased moving downslope following the catena concept. Depth ranged from a minimum of 0.05 m to a maximum soil depth of 2 m, with an average soil depth of 0.44m and median of 0.22m. Soil depth was found to be correlated with elevation. However, no significant relationship was found between soil depth and surface slope or soil depth and upslope contributing area. No relationship was found between soil depth and topographic wetness indices. The soil depth data was used to produce a bedrock DEM. Examination of the bedrock topography showed that similar to the surface topography findings, there was no relationship between bedrock slope or bedrock upslope contributing area and soil depth but a statistically significant relationship was found between bedrock elevation and topographic wetness indices. This suggests that subsurface hydrology and soil moisture play a significant role in pedogenesis and are decoupled from surface topography.