Integrating Different Conceptual Models In Studies of Topography-Soil Relations: The Importance of Chronosequence-Based Studies

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A deterministic model for soil-mantled, creep transport-dominated slopes that simulates diffusive soil movement is used in studies of the evolution of transport-limited slopes (e.g. Heimsath et al. 1997). Key model aspects are that (1) soil production (SP) is defined as the rate of bedrock-to-soil conversion; (2) application is usually confined to weakly pedogenically modified colluvium; (3) weathering reduces bedrock shear strength and enables slope transport, after which soils form largely by physical weathering processes (e.g., bioturbation); and (4) the soil production function is significant, with a focus on upper slopes where positive slope curvature is assumed to increase SP rates. CRN dating can determine SP rates, but only in a steady state slope-soil system. Favorable factors make the Oregon and California Coast Ranges appropriate natural laboratories for studies using this model. A different conceptual model in studies of soils is the Jenny (1941) factors model. Soil development is evaluated as a function of soil-forming factors, including topographic position. Soil profile development couples both colluvium and subjacent slope materials (whether bedrock or surficial deposits). Studies of toposequences (sequences of soils on a slope) show that soil properties usually correlate strongly with slope position and associated processes, e.g., footslopes often show thick, well-developed profiles promoted by downslope concentration of mineral and organic matter and water. Interflow, dust incorporation, and changes in climate, topoclimate, lithology, and biotic communities strongly affect soil forming processes, which in turn influence slope form and evolution by e.g. progressively changing infiltration/runoff ratios, potentially displacing soil-slope systems from steady state. Chronosequence studies help elucidate strongly time-dependent soil forming processes in geomorphically stable landforms where the SP function is largely irrelevant, and provide critical insights for toposequence studies. These two models could potentially complement each other, but this will require reconciling contrasting conceptions of soil profile development.