



Soil mixing and transport on steep pastoral slopes: North Island, New Zealand

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Convex hillslopes are typically the domain of high soil production rates and thin soils, related to the increasing mass flux in the downslope direction. Concave hillslopes tend to be depositional, with lower soil production rates and thicker soils. Hillslopes in pastoral settings have often been stripped of trees and shrubs in order to support grazing animals. The loss of vegetation can lead to extreme erosion of the existing soil stores. We have sampled 8 soil pits along two transects on a convex/concave hillslope in a typical pastoral New Zealand setting. While soil depths measured here support the idea of steady state soils with a negative depth/curvature relationship, the immobile element concentrations suggest more complex movement.

The initial results suggest significant downslope transport of both dissolved and solid mass as well as mass addition to the soil. In a purely surface erosion-driven system, immobile element (Zr, Ti, Y, etc.) concentrations should increase towards the surface as other elements are preferentially removed. Likewise, soil density should increase with depth in a soil pit. None of the traditional immobile elements correlate well with soil depth. This suggests that these soils have undergone extensive mixing. High soil densities in the lowest convex soil pits further suggest that either significant soil erosion has occurred at the lower pits, or that mass is being advected down slope. The latter would also account for the dilution of zirconium. An alternative hypothesis for explaining the low concentrations of immobile elements in the soils is the addition of mass. This is a reasonable scenario in the lower North Island of New Zealand, with major volcanic centers within ~200km of the sample site. However, major cation concentrations increase in the downslope direction suggesting that advection of mass from the upper slope is the dominant mechanism.