Calibrating weathering functions from hillslope soils

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Quantifying rates of weathering is important for understanding and modelling the biogeochemistry of important nutrient elements. To date, time-dependent weathering functions have been calibrated experimentally or by using soil chronosequences. However, applying weathering functions to hillslope soils is problematic because such soils do not have a well-defined soil age: instead, soils on hillslopes are made up of an ensemble of particles of different age, determined by their time of release from the soil parent material below the soil and all points upslope. The theoretical gap is significant because hillslopes and hillslope soils dominate the Earth's surface and we need a framework for assessing the controls on mineral weathering and nutrient supply. In this poster we present a theoretical treatment of chemical weathering, assuming steady state hillslope soils, and weathering described by a power law function of particle age. We apply the theory to the calibration of a weathering function for apatite P for the extreme weathering and soil production environment of the western Southern Alps. The analysis predicts the kinetic limitation of apatite P weathering at high soil production and erosion rates, and suggests an optimum soil production (and erosion) rate for ecosystem P supply. The theory may be applied to any soil mineral or element, but relies on a minimum data set for calibration, namely: soil production rate, soil depth, chemical depletion factor (determined from a stable element, e.g. Zr), element concentration in the parent material and the soil, and soil and bedrock bulk densities.